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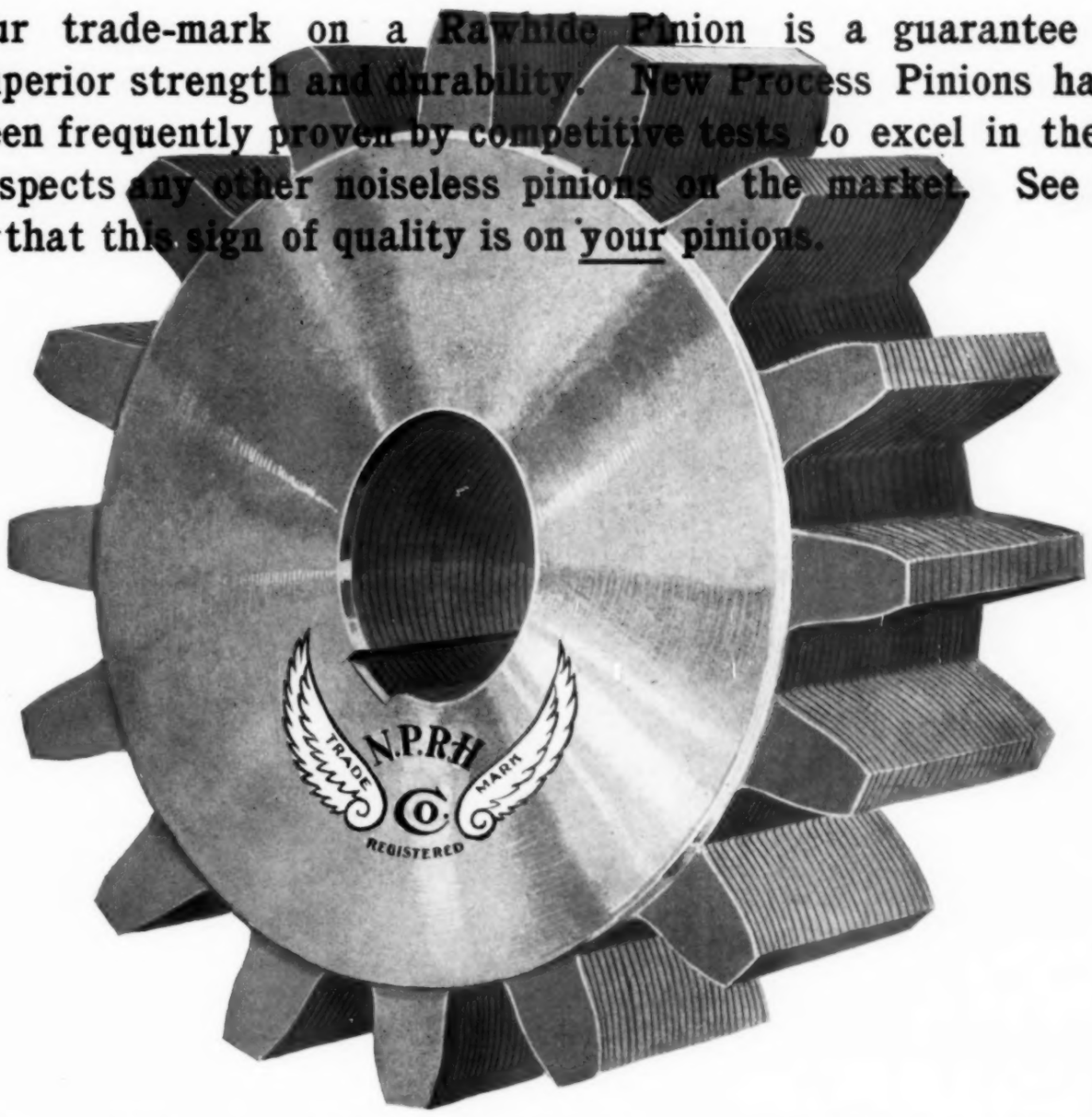

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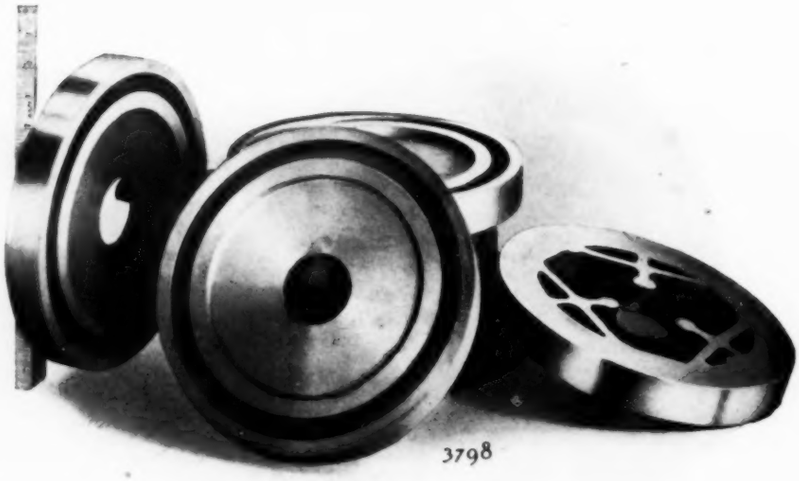

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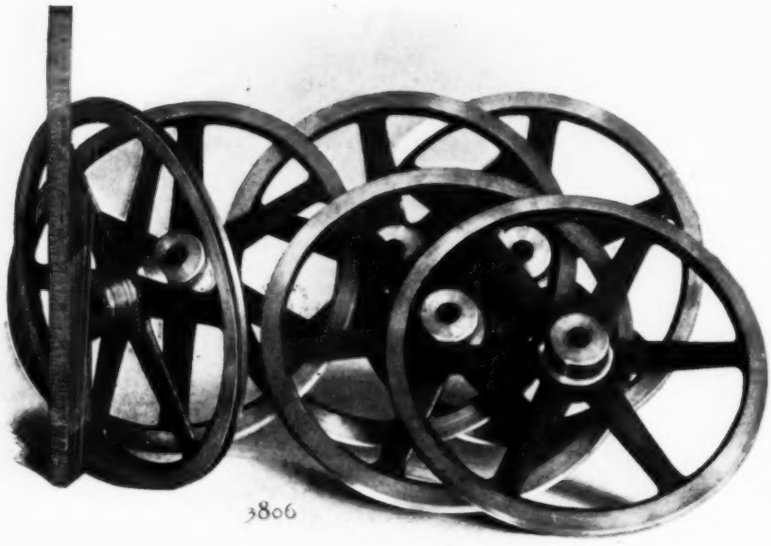

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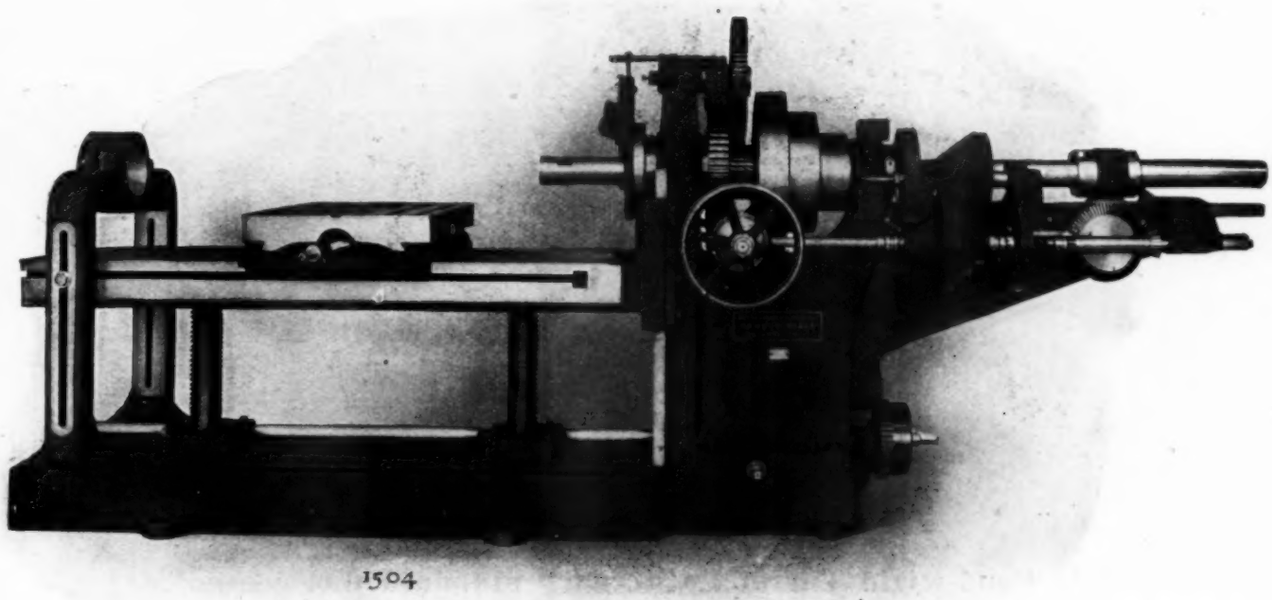

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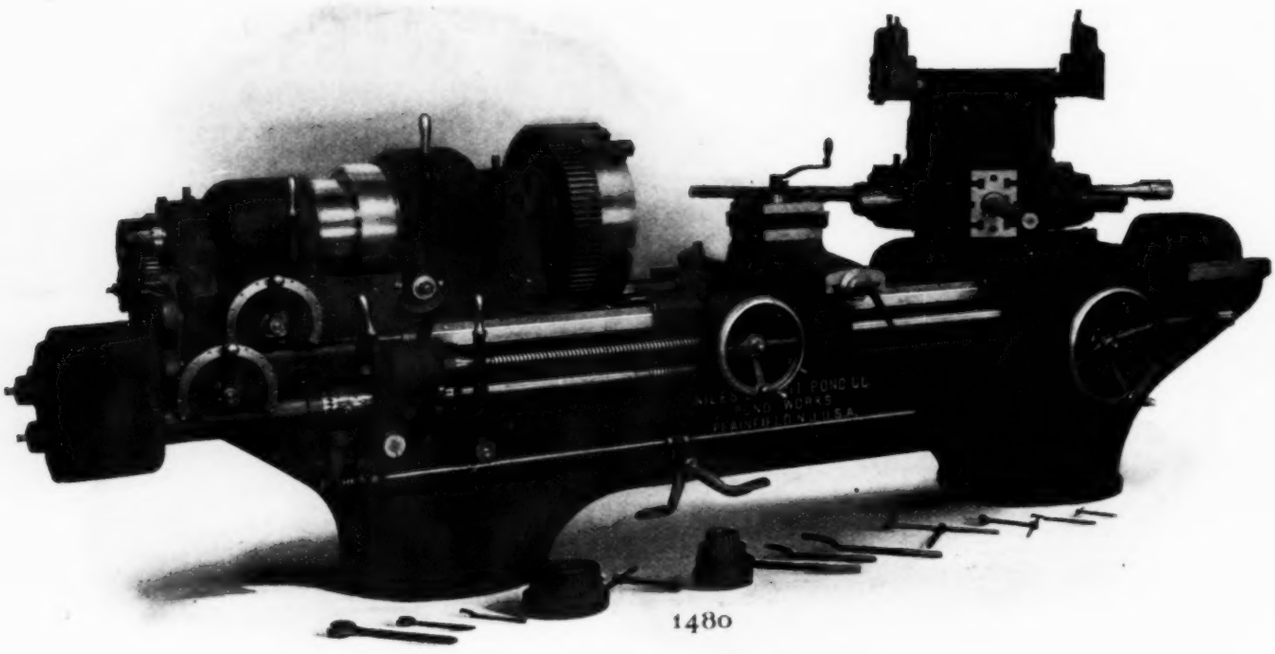

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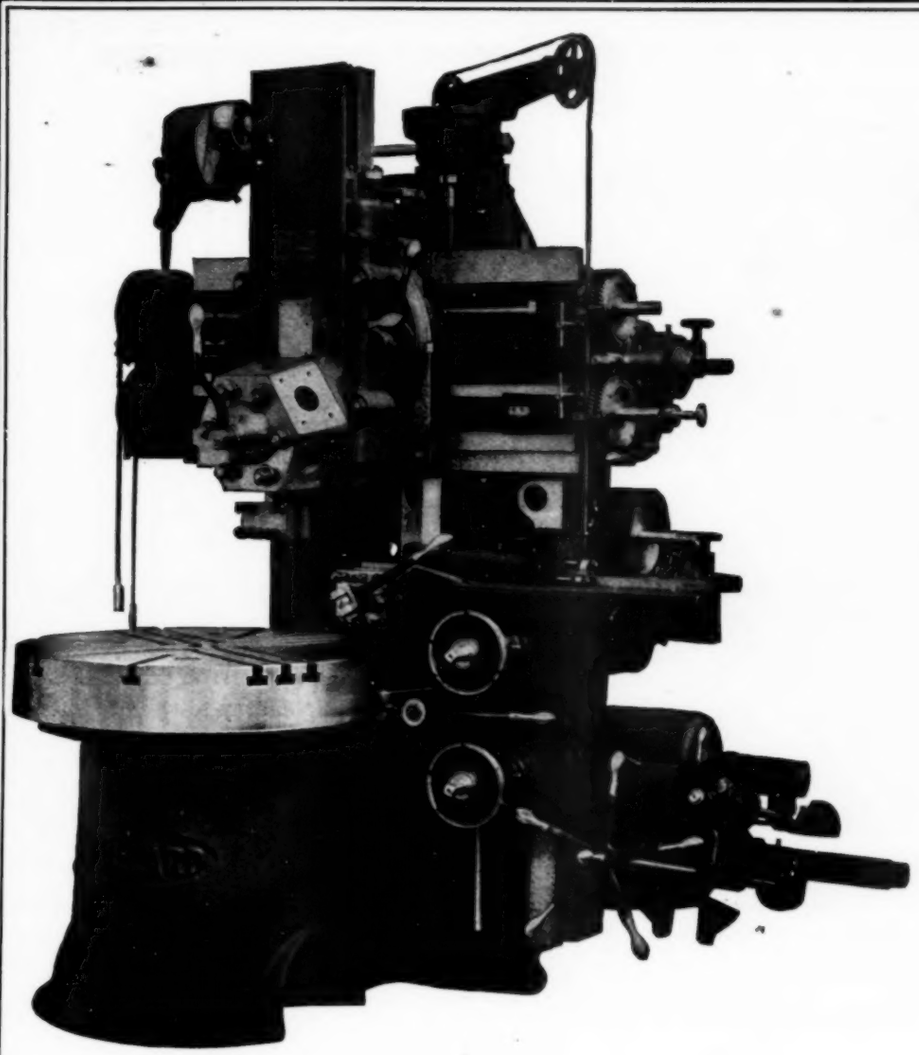

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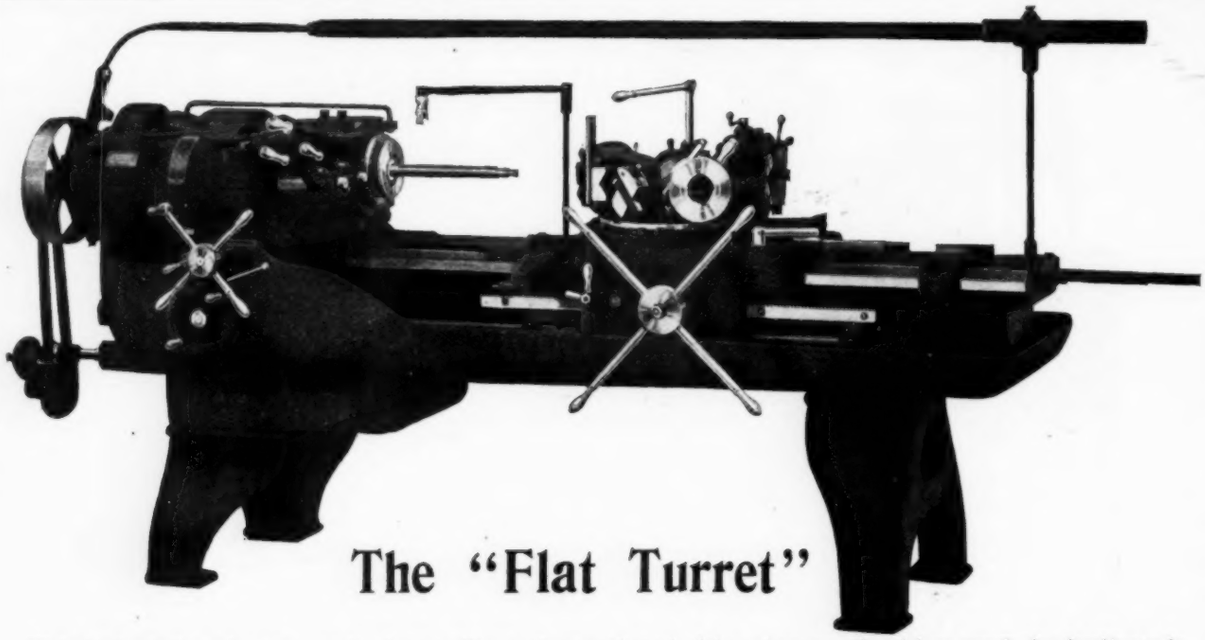

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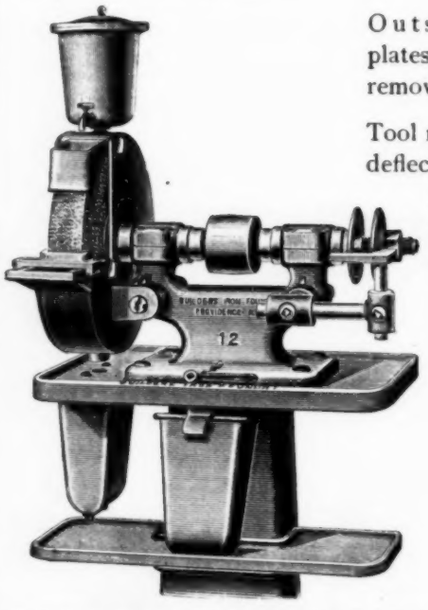

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The Method of Producing Die Castings

The Process of Casting. Molds, Melting Pots and Casting Machines, also Some of the Castings and Compositions of Metal Used

BY E. LUTHER LAKE

Of recent years a new and invaluable method of producing castings in a non-ferrous metal has sprung into existence. These castings are made of different compositions of metal and can be used wherever brass is strong enough for the work required of the part cast. Some of the compositions nearly equal the bronzes in strength. These castings are made in steel die molds which are machined, filed, scraped and ground to fit together in sections in such a way that when the mold is closed the molten metal can be forced in under pressure, which varies for the kind of casting required. The castings produced are within a fraction of a thousandth of an inch of the size desired.

The molds being of steel they are given as smooth a surface as is possible and the metal being of a composition which has a fine grain with no small holes or gas bubbles in it, the castings are given a smooth, mirror-like surface which is as nearly perfect as the most accurate machinery and tools can produce.

Holes of any size and shape are cast in them as nearly perfect as an accurately ground reamer can make them. Both internal and external threads can be cast to the exact size to make a nut or screw a tight or a loose fit. In fact they can be cast as nearly perfect as it is possible to make a tap or die, owing to the fact that the molten metal is forced in under pressure so that it fills every part of the mold and is held there until it has cooled sufficiently for the mold to be opened and the casting taken out. Holes are also cast as nearly perfect in their distances from one another as it is possible to make jigs, drills, or reamers do the work.

They are sometimes called finished castings, because complicated and intricate parts made in the ordinary way require any amount of machining, filing, fitting and polishing, while these are cast so smooth and so accurate in size and shape in every detail, including holes, slots, lugs, spurs, threads, gear teeth, letters or numbers, etc., that all finishing is done away with.

Compared with Old Method

In Figs. 1 and 2 are seen a few styles of castings made by this process. A comparison with the old methods used will show the saving effected by their use.

If we take the one shown in the upper right-hand corner of Fig. 1 we will see that first a wood pattern has to be made; then a dozen castings are made, finished up and gated into a metal pattern, as shown in Fig. 3. The castings are then made and brought to the machine shop for finishing.

In the machine shop the first operation is to clamp the pieces in a milling-machine vise provided with special jaws to fit the piece and then mill off the surfaces marked 1 and 2. The next operation is to turn the pieces over and mill off surfaces 5 and 6, next milling off surface 3. Then turning it over, the opposite surface, which is not shown in the half-tone, is milled off. A number of pieces can now be clamped in the vise and surface 7 milled. The next operation is to drill the holes marked 8, 9, 10, 11 and 12, and ream out hole 8, after which slot 13 has to be cut.

FIG. 2. MORE INTRICATE DIE CASTINGS

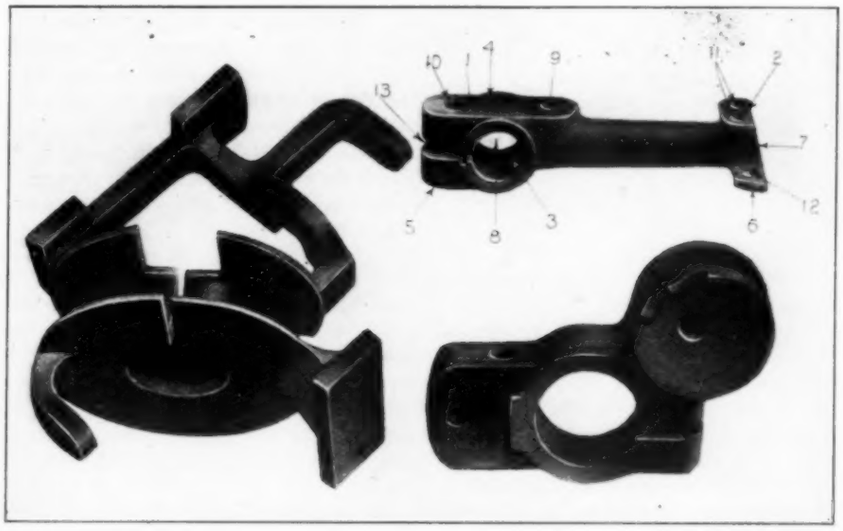


FIG. 1. SOME SAMPLES OF DIE CASTINGS

To make these holes as exact as they are in the castings would require a jig similar to that shown in Fig. 4, to insure the correct distance between the holes and that they were drilled straight and square with the other surfaces.

The other castings shown in Figs. 1 and 2 would be much more difficult to machine by the old method, and those in Fig. 2 would be practically impossible to make by using rough, ordinary castings and afterward machining. For instance, the inside gear teeth on the large disk, the figures on the outside diameter of the small disk or the bar which runs across the webs on the long piece on the left of the half-tone could be machined only with a great deal of labor. Thus it is possible to manufacture to the exact size finished die castings which it would be almost impossible to make by the old methods.

The Molds

As against this labor incurred by making pieces by the old method is the cost of the molds, as each piece has to have its own steel mold but this cost decreases per casting with the increase in the number of castings required from each mold. The molds if properly made will not wear out until a large number of castings have been made.

The molds are paid for by the one purchasing the castings, after which the castings are paid for at a price per hundred varying with the work required and the metal used in casting them. These molds, however, do not become the property of the purchaser, but remain in the possession of the casting companies, owing to a certain amount of secrecy which is maintained. For this reason, as well as to save the profits, I have been employed at different times by a few of the larger manufacturers to put in a molding maching and make molds for it so that they could make their own castings.

The molds are, many of them, very intricate in design and require the utmost ingenuity on the part of the tool-, die- or mold-maker to construct them so that the castings can be taken out and the partings of the mold reduced to the lowest number. The plain and the threaded rods which are put in the molds to make plain or threaded holes must be placed in such a way that they can be taken out in the easiest and quickest way, and by a boy or an unskilled man, in order to produce the castings as quickly and cheaply as possible.

Then again the mold must be constructed in such a manner that the metal will flow into all parts of it. It should not be made so tight that air pockets will form and cause holes in the castings; at the same time it should be tight enough to hold the metal and not cause fins to form on every line on which the mold is parted.

The air is usually let out of the mold by filing fine grooves in the surfaces of the mold where they come together to form the partings needed.

While there are many problems to solve in the making of the molds, it is such work as is performed every day by the skilled die-, tool- or mold-maker who uses his brains as well as his hands.

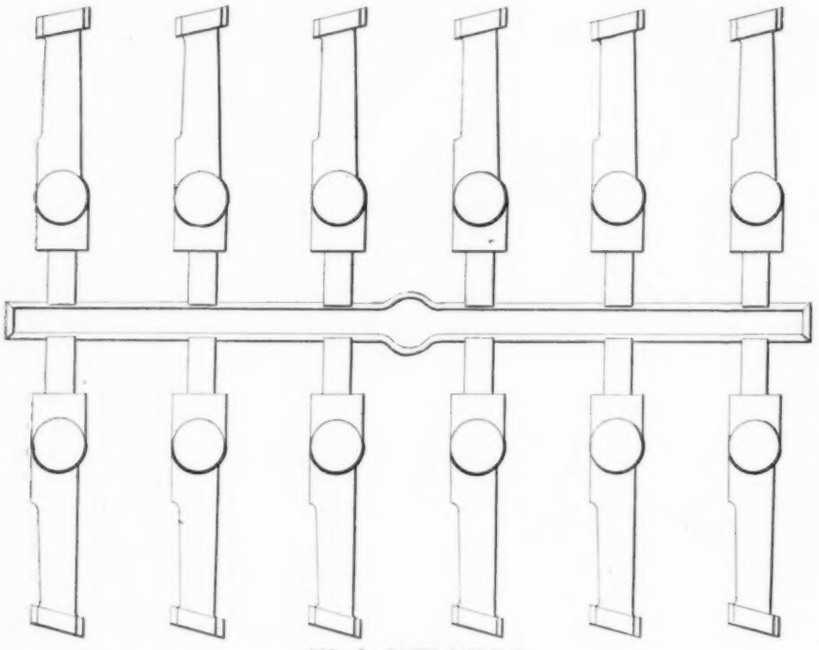


FIG. 3. GATED PATTERN

The mold is practically the only item whose cost should be charged up against the numerous operations performed in manufacturing pieces by the old method, as the castings are turned out much faster than they can be by molding in sand; the metal is no more expensive than that used for similar work cast in sand; and the molding machine with its melting pot can be used for any number of different kinds of molds. In fact its only limit is the life of the machine.

The Molding Machine

In making castings the metal to be used is heated to an easy flowing state, at which point the temperature of the metal is easily held by mechanical means, and forced or injected under high pressure into the molds. Substantially the same principle is used as that involved for many years in the linotype machine: after the operator—a compositor—has set up a line of type of the matter to be printed, the machine makes a casting of it.

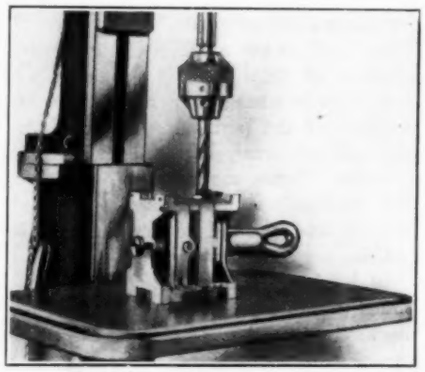


FIG. 4. JIG FOR DRILLING

Fig. 5 shows a type of molding machine in which the mold *M* is placed over the melting pot in a horizontal position. *A* is the melting pot, *B* the nozzle, *E* the cylinder, *F* the piston, *G* the lever for operating the piston, *D* a brick casing around the pot to retain the heat, *L* a gas burner to heat the metal, *I* the chamber around the pot, *T* an outlet for the heating gases, *C* a chute through which the metal is charged, *H* a valve to close the same, *K* an opening with cock for emptying the pot.

In operating this the mold *M* is hinged at *N* and clamped down over the nozzle *J*; then the lever *G* is thrown over to move the piston *F* quickly inward, thereby creating the pressure necessary to force the molten metal rapidly through nozzle *J* into the mold *M* and fill the entire space before the metal begins to cool. The mold is then opened, the casting taken out and the operation repeated.

An Automatic Machine

In Fig. 6 is seen a molding machine which works automatically and can be power driven. In this the mold *G* is screwed on to the end of the nozzle, as shown at *H*, *A* being the melting pot, *B* the gas inlet and burner, *C* the reservoir around the melting pot and *I* the exhaust gas outlet.

In operating, the wheel *J* turns until the cam *K* brings the lever *L* down to its lowest point. This, operating on lever

M, raises the piston *D* up until the passage *E* fills with molten metal. The cam then passing the cam roller at its highest point allows the spring *O* to push the lever *L* up, which forces the piston *D* down into the passage *E*. This in turn forces the metal into the mold *G*. When the mold is filled, the valve *F* closes the opening into it; this feature saves the cutting off of the casting at this point. The casting is then taken out of the mold and the operation repeated.

Fig. 7 shows a method of using compressed air to force the metal into the mold.

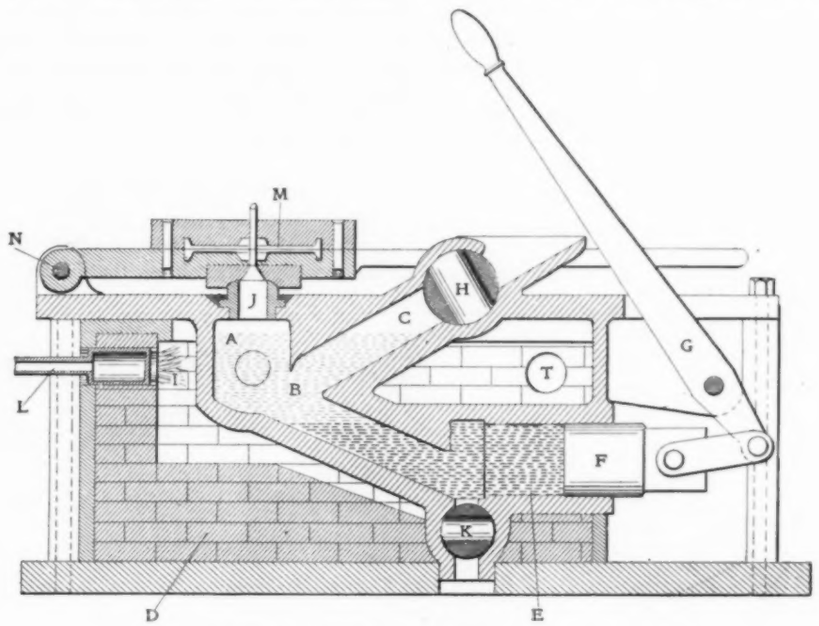


FIG. 5. MOLDING MACHINE WITH MOLD LYING FLAT ON TOP

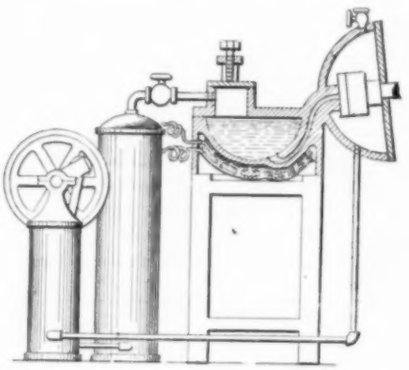


FIG. 7. COMPRESSED AIR MOLDING MACHINE

Many of the details of the molding machines have been patented, but the main principles—a melting pot provided with a cylinder with its spout or nozzle, a piston to inject the metal into the mold, and these provided with levers for operating and means for heating the metal—have been in use so many years that they are unpatentable. In fact the linotype machine has made these castings automatically for a good many years but confines itself to a line of type as shown by those used to set up this article, the mold being made by the operator who presses on the proper keys in a key board and the machine does the rest.

The Metal Used

In choosing the metal or metals to be used, the work which the piece has to do should be taken into consideration as well as the necessity of making a composition that will work well in the molding machine. An almost unlimited number of alloys can be compounded to produce castings from the softest to the very hardest; but the metal should be of such a nature that it will have a fine, close grain and be free from porosity as well as one that does not have too much shrinkage.

Four compositions of alloys which have given good results for this class of work analyzed as follows:

1. Tin, 14.75 per cent.; copper, 5.25 per cent.; aluminum, 6.25 per cent.; and zinc, 73.75 per cent.

2. Tin, 19 per cent.; copper, 5 per cent.; lead, 2 per cent.; aluminum, 1 per cent.; zinc, 72.7 per cent.; and antimony, 0.3 per cent.

3. Tin, 12 per cent.; copper, 10.6 per cent.; aluminum, 3.4 per cent.; iron, 0.2 per cent.; and zinc, 73.8 per cent.

4. Tin, 30.8 per cent.; copper, 20.4 per cent.; aluminum, 2.6 per cent.; and zinc, 46.2 per cent.

Compositions Nos. 1 and 2 are suitable for ordinary work such as could be performed by the average brass casting, while compositions Nos. 3 and 4 are harder, particularly the latter, which is unusually hard and should be used only where hardness is absolutely necessary; but as said before, these percentages can be varied in such a manner as to suit the requirements of the piece to be cast.

The aluminum is added in such percent-

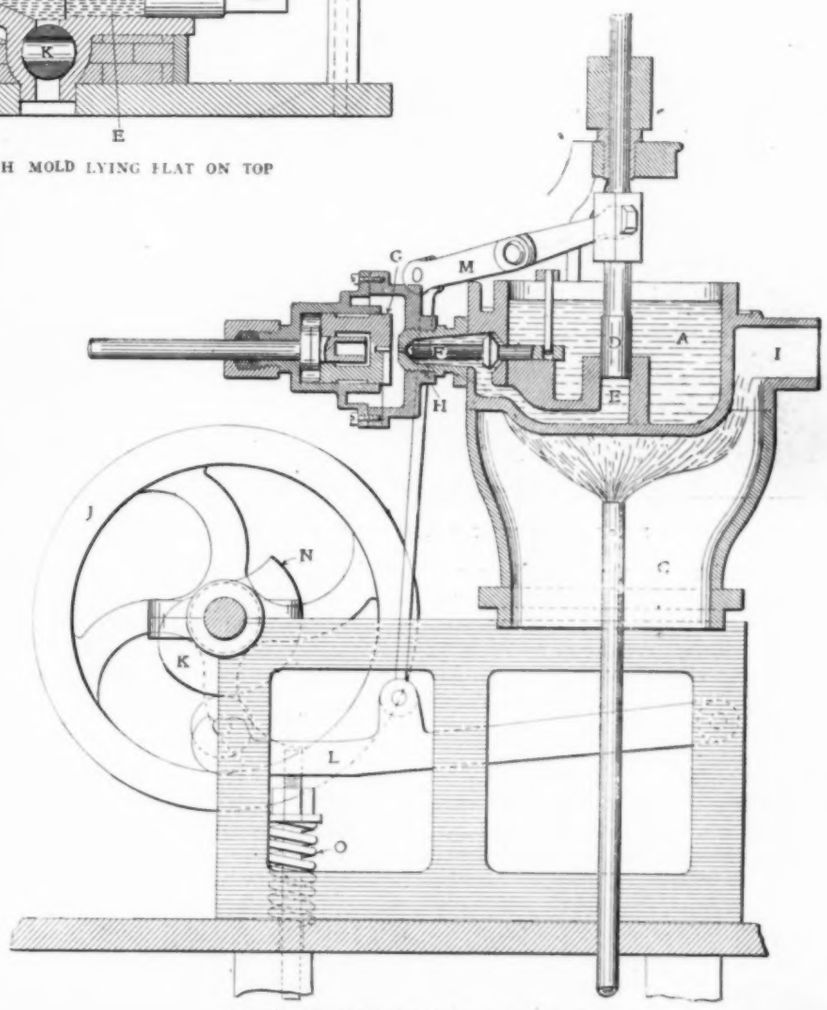


FIG. 6. AUTOMATIC MOLDING MACHINE

ages as will make the metal flow easily, while the other ingredients give it the necessary hardness, softness or toughness.

Adaptability of These Castings

By this process many thousands of duplicates can be made so accurately that the variation in any measurement will be less than a thousandth of an inch.

Any shape or size of piece up to 12 inches in diameter and 3 or 4 pounds in weight is made by this system; much more difficult work and intricately shaped pieces can be formed in this way than by the old machining methods, and at a considerable saving in the cost of production.

The metal can be made to vary in strength and hardness from that of cast iron to that of lead, or it can be made as tough as bronze or annealed brass according to one's requirements; and it can be plated, oxidized or given other finishes desired.

The scope is wide in the field of adaptability for such castings and includes parts for a large number of instruments and machines such as telegraph, telephone and optical instruments, voting and slot machines, cash registers, mutoscopes, phonographs, time clocks, accountants' machines, electrical apparatus and many other similar things.

Many experiments are being made to cast by this method phosphor, aluminum and manganese bronze as well as other alloys, and with the progress which is being made in metallurgy, castings may be made in the near future which will cover a wider field of usefulness.

The total number of vessels arriving at New York during the year 1907 was 4749, of which only 726 were American.

Grinding Cone Pulleys

By J. H. Hollinger

The progress and improvement in grinding machines during the past few years have been especially marked in their development for manufacturing purposes; this has led to the grinding of many things which were formerly finished with cutting tools.

Where a cut of ½ or ¾ inch in width was common, now 2 inches or more is regular practice; and where the removal of 1 cubic inch of cast iron per minute was considered exceptional, today 2 inches is regular practice, and as high as 5½ cubic inches has been accomplished experimentally.

Grinding from the rough, particularly cast iron, is very common. Cast-iron drums 3 inches diameter by 33 inches long are reduced and finished in the average time of 20 minutes. Steel from the black bar is another good example. As an illustration, shafts 101 inches long, 1¾ inches diameter, are ground to 1 11/16 inches diameter in 90 minutes in regular practice.

One Application of Grinding

Another departure is the grinding of cone pulleys; these are roughed on the lathe with a straight face, then crowned and finished by grinding, leaving a radial crown. For instance, a pulley having three steps respectively 15, 16 3/16 and 17⅛ inches by 3¼ inches face is crowned by grinding at the rate of three or four an hour.

Some interesting and profitable pulley grinding has been in progress at the works of the Landis Tool Company for the past few years. Cast-iron cone pulleys used on their countershafts run from 475 to 1500 revolutions, and in addition to being balanced, they must be run true within the very small margin of half a thousandth.

This accuracy has been very hard to obtain on the lathe, which also consumed considerable time in the operation. The pulleys, after being crowned, were filed and polished, making two additional operations, and the forming tools had to be made and kept in cutting condition by the toolmaker. Now this work is all done on the grinding machine, eliminating the filing and polishing, and producing a pulley far superior to what they have been able to obtain by any other method.

Radial Fixture

The radial truing device (Fig. 1) comprises several very desirable features, one of the most important being that it can be set in position, with reference to the work, for any size coming within the range of the machine without the necessity of feeding the wheel forward past the work and back again in the truing operation. This is accomplished by moving the head piece toward the wheel until the diamond comes in a line with the surface to be ground, in which position it is clamped. It will be noted in re-forming the wheel that this can be quickly done by moving it along from the work to the truing fixture, which is located and fastened in a convenient position on the table.

The radii of the different crown shapes are obtained by tilting the head piece which carries the diamond and the feeding mechanism toward the wheel for increasing the radius, and in the opposite,

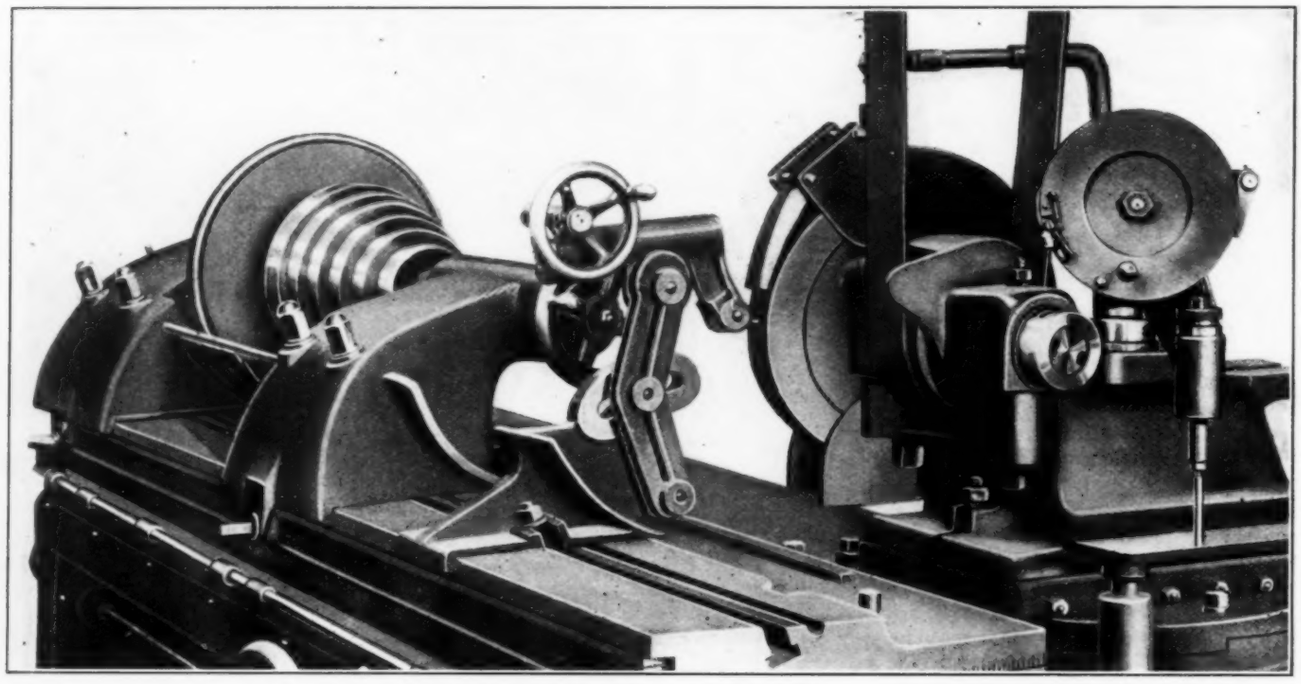


Fig. 1. Machine for Grinding Pulleys with Attachment for Truing the Emery Wheel

decreasing it. It will be clearly seen that with the spindle, which rotates, the diamond, which is set in a position tangent to the face of the wheel, will form the concave on the shortest radius for which the fixture was made, which will be equal to the length of the arm carrying the diamond.

With the spindle set in a horizontal position, the form of the concave of the wheel will be more of an obtuse shape, or in position to give the greatest radius possible with this fixture; it has also been figured in the design of the machine to give the correct crown shapes for all work for which it has been specially adapted, coming within the range of the machine.

The Pulleys

The 100 pulleys shown in Fig. 2 have steps respectively of 2 13/16, 4¼, 5 19/32, 6½ and 7⅞ by 1⅜ inches face, and were rough turned on the lathe, leaving a straight surface within 1/32 inch of the size wanted; these were gained in at each shoulder to relieve the corner of the wheel and ground to size in 8 minutes apiece. The actual grinding time on each step was 30 seconds. It made a nice clean surface which was far superior, from a commercial point of view, to any that had been filed and polished or finished by some other method.

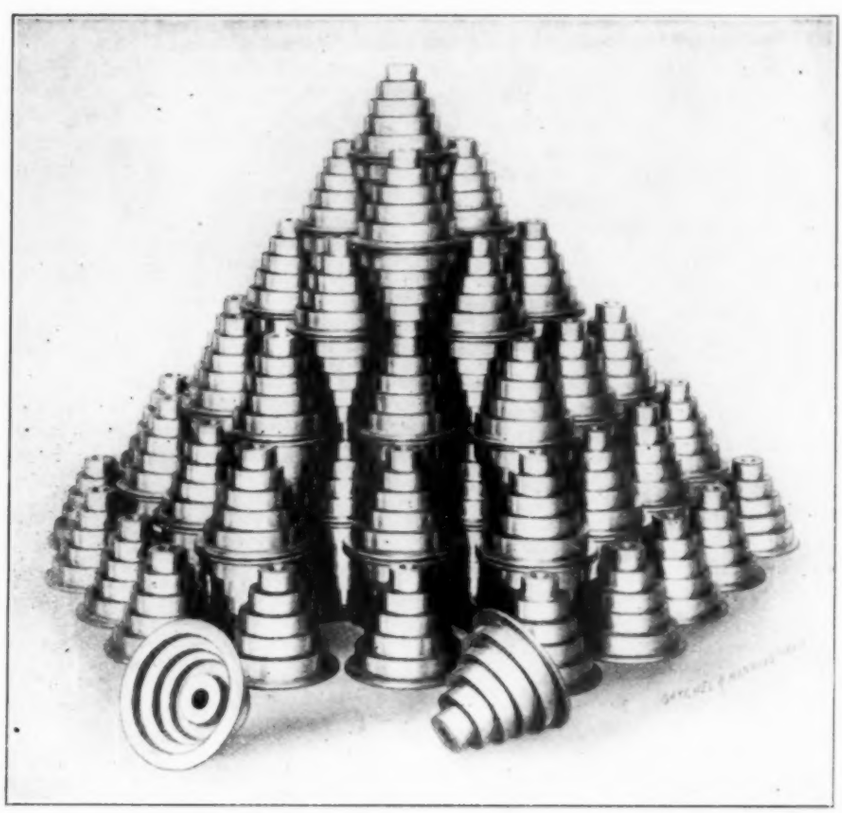


FIG. 2. A PYRAMID OF PULLEYS FINISHED BY GRINDING

A 36/46 adamite wheel of a medium grade, or one grade harder, made by the silicate process, seems to give the best satisfaction on this class of work. These wheels are very keen cutters, which is necessary to produce true work. Vitrified wheels also work well, but do not seem to retain their cutting efficiency as long as the adamite. Wheels for this class of work are from one to two grades harder than those generally used on the machines, as these wheels will retain their shape for a longer period than others, owing to their having more cutting to do on the corners than in the center.

A Set of Curious Snap Gages

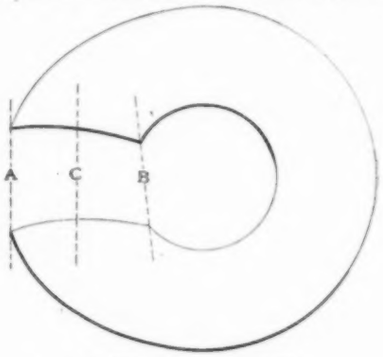
F. S. Brown

Of late there has been much discussion in these columns about peening gages. The gages here described have the advantage that they are always correct(?), and never need peening or adjusting.

They were shaped as shown in the sketch, and made from flat steel ⅜ inch thick. The length of the jaws from the mouth *A* to the heel *B* was about one inch for all sizes. They were arranged in standard sizes, the mouth being about 0.005 inch large and the heel 0.005 inch small.

The correct size was somewhere between *A* and *B*, but there was no line *C* to indicate the spot. The faces were not quite flat, as could be seen by placing a straight-edge on them; one was generally concave and the other convex as shown, but, to vary the monotony I suppose, some gages had both faces concave, while both faces were convex in others. The faces gave unmistakable evidence of having been lapped with emery-cloth on a file, and were highly polished.

What a soft "snap" the machinists in that shop must have had! The lathe hand who had a long job between centers could put on a finishing cut at the tailstock adjusted so that the work was correct to the heel of the gage. He could then hide away and have a quiet smoke confident that on return to his lathe the work would be correct to gage. It would fit somewhere between the heel and mouth unless the job sprung very much, or the lathe was very bad. Likewise the man on the grinder could set his automatic feed stop to make his first piece fit the heel of the gage, and not pay any more attention to that part of the business for two or three hours. He might even instruct the kid, snagging castings near by, to take out finished pieces and put in fresh ones and himself take a sleep or read the newspaper for a bit. If he had a large run of work and studied his wheels well he would get so expert as to be able to calculate the time required for the wheel to wear down sufficient so that the job would just fit the mouth of the gage, and wake up at that time.



A CURIOUS SNAP GAGE

It will be seen also that these gages could, by a little (?) intelligence, be used for different classes of "fits" by the machinist carefully calculating and marking the spots on faces where the work should ride for running, force and shrink fits.

Some readers will doubt the existence of these gages. They were found less than two years ago in a large engineering works about 3000 miles from New York, and kept in a nicely polished wooden box on which was a brass plate inscribed

MANUFACTURED AT ——, etc.
in the year 190—, etc.

Near by was a new 6-inch vernier with jaws four inches long sliding on a *brass* beam. The idea of the long jaws seems to have been the same as the taper in the gages. If work was a little large (a thousandth or two) it would nevertheless easily enter the jaws, they had so much spring.

Layout and Installation of Steam-pipe Lines*

Care in Proportioning Sizes, Selecting Materials, Planning Details and Erecting Is Essential for Steam Lines in Industrial Plants

BY WARREN H. MILLER

The first principle to stand upon in laying out steam-pipe lines is, Never use "standard" fittings on live-steam lines. This is, of course, on work above 1½-inch pipe size. Trade competition has of late years so thinned down the metal in "standard" fittings that the manufacturers themselves no longer recommend them for live steam. On anything above 125 pounds boiler pressure it is well to use "extra heavy" fittings, but all pressure at and below this can be taken care of very nicely by what are called "medium fittings."

In laying out work, use flanges wherever joints are saved thereby; or when the work would be difficult to put up with screwed fittings; or when the work is liable to be taken down again for changes or accidents. Remember that it takes six men, a pair of hold backs and a large chain tongs to screw up 6- and 8-inch fittings, and that it is often impossible to do this at all in pipe galleries and the like. This work must be made up on the floor, where there is room to hold it and get at it. Every section containing screwed fittings should terminate in flanges before it gets too ungainly to handle, so that it can be hoisted with chain blocks and bolted into its place in the line. Ring gaskets which can be dropped into place inside the bolt circle are the only ones used in present-day flanges.

As regards sizes of screwed fittings, they may be used freely up to 10-inch sizes on live-steam work. Flanged fittings are slightly stronger, but the main consideration in their use is the saving of joints and the arrangement of division points to get into the screwed work. In straight line work it is well to provide one flange coupling to every five lengths of screwed pipe.

Boiler Fittings and the Main Header

Beginning with the boilers, the first thing that goes on the boiler nozzle is an automatic non-return stop check valve. This can be closed by hand, but cannot be opened except by the steam. In case a row of tubes blows out in the boiler, the valve automatically shuts and prevents all the other boilers from blowing their steam into the boiler room by way of the burst boiler.

Following this valve is a long-sweep bend leading to the main. This should always be of extra-heavy pipe, as the metal thins considerably on the off side in bending. Of course, both the stop check and pipe bend should be flanged. The radius of the pipe bend should not be less than eight times the diameter of the pipe. A straight shank should be left about 1½ times the diameter of the pipe for the grip of the bending machine. The bend may leave the boiler nozzle either vertically or horizontally, preferably the former. They work quite as well horizontally, however, and no radical changes in the placing of the boilers should be made to get head room enough for vertical bends.

Between the pipe bend and the main place a gate stop valve. Get the best one you know of. It will be used constantly, and if really tight and well made will save much hard feeling. In designing the main header, there is a great temptation to go into large sizes of pipe. No greater mistake can be made. Keep down the size of the main all that is possible by leading off taps judiciously so that each boiler has a corresponding tap to take care of its steam. Make no provision for the spare boiler. It will never be used except when another boiler is down.

Another temptation in laying out the main is to stick in a variety of division valves to meet various imagined contingencies. These can be boiled down to one, or at most two, division valves; at that, the bonnet gaskets of these will be the first to go. At other points of possible trouble put in rings and keep blanks of the same thickness handy in the engine room. Any accident that would lay up such a section will give ample opportunity to take out the ring and slip in the blank, thus cutting out the damaged section. A stop valve seems handier, but the ring has the advantage that it does not get out of order. Any valve not used oftener than once in two or three years is sure to be in no condition for service when called upon by the emergency.

If the plant is large enough to permit a complete ring to be made of the main at little additional expense, it is, of course, the proper arrangement. Unfortunately, as the average industrial plant does not use over a thousand horse-power, this plan is not feasible with an ordinary battery of four or six boilers. In cases of this character, an auxiliary main will prove well worth the outlay. Select the shops or engines that *must* have steam to keep the plant moving, and choose the proper size of pipe to furnish this supply. This will be the auxiliary main. It should connect to all the boilers through a tee at the nozzle, and to the main at both ends. This makes a ring of the boiler piping, and such a plant is hard to put completely out of business. There is scarcely an accident anywhere that cannot be shunted around somehow by way of the main or the auxiliary. To take care of the water which condenses in the main on shutting down, a drip pocket should be placed at about its middle and connected to the hot well. It will not do to omit this, even considering that the main is normally dry. The flow of steam is in a number of contrary directions; every time a fresh boiler is put on, or a cut-out section put in, its condensed water must disappear down a drip pocket or else it will rush up and down the header with a terrific water hammering.

The normal state of the auxiliary should be empty with all valves closed and its drip cock open. The reason for this proceeding is that if left normally full of steam it is certain to hold a quantity of dead condensed water. If anybody closes or opens a valve on the main, or does anything to alter the normal flow of steam, the auxiliary immediately tries to furnish the difference. Its contents of inactive steam are at once set in motion and with it all the loose water. The hammer that ensues is not only astounding in its energy but exceedingly dangerous to all the fittings. One experience will be enough to make the manager rescind his "auxiliary open" order and will cause the designer much thankfulness that his fittings are better than "standard" weight.

Transmission Lines

On the main transmission lines the first consideration is to see that all pipe is pitched in the direction of the flow of steam, and has a fall of from 1 to 2 inches in 15 feet, depending upon its size. Ample drip pockets should be placed at intervals of 300 feet in the line and provided with a trap to take care of condensation. It will not do to leave only a hand valve on the drip pocket. Three hundred feet of well covered 8-inch pipe will keep a No. 3 Nason trap, or its equivalent, busy in winter weather. If you try to leave the hand valve dripping, the pocket will fill in less than 10 minutes, for the reason that steam will go down through the water and get out first; paradoxical as this may seem, the only way to get out the water is to open the

*Copyright, 1908, by Warren H. Miller.

hand valve wide, when it will come out slowly with the great volume of steam. It is because of this peculiarity that a trap must be used.

The next point to be provided for is expansion. You can count on 2 feet of expansion for all sizes of pipe for every 100 feet of length between a cold state and steam-heat temperature. Avoid all patent expansion joints; they are only one more nuisance to keep packed, and the whole line has to be shut down every time it is done. The best plan is to provide two screwed ells at every right-angled turn. Where the run exceeds 300 feet between swing ells, the line should be anchored in the middle by a collar and double tee rods.

How to Warm Up a Steam Line

Starting up a new steam line of any length and size is always ticklish business. Every vertical angle should have a 1-inch drip, and these should always be gate valves. The line is sure to be full of pebbles, sticks, pipe scale, rags of shirts and gloves, and other smaller dirt, which have crept in unawares when the pipes were being made up on the ground or hoisted into position. I recall one line that gave up a complete pair of overalls in a 6-inch bull-head tee 900 feet from the boilers. Even the smallest of these obstructions will stick in a globe valve and jam it tight, so that there is nothing to do but to shut down the whole line and take off the valve.

Do not start up with the lines bare if it can be avoided. The condensation is enormous and very hard to manage so as to avoid water hammer. Warm the pipe up slowly, letting in steam from some small valve, say the auxiliary connection. The pipe will creep in the direction of the steam, and, when it comes to an anchor, hump up like a cat's back for 50 or 60 feet of its length until the expansion works back to the swing joint, when it gradually subsides. This is alarming to see, but no accidents will ensue unless there is a flange coupling in the bend. This would crack, and should be secured to avoid this very trouble. To ease up this tendency, one can set all the pipe hangers so that they pull the pipe back toward the swing joint, and thus carry back the expansion as it occurs. Or, if possible, steam should be put in near the anchor and the pipe warmed both ways from it. Allow about one-half hour for a line of four or five hundred feet in length to come up to boiler pressure.

Do not allow any dead lengths of pipe to stand overnight with the steam on them. What happens is worthy of consideration. The pipe acts as a condenser, and slowly but surely fills with water. As soon as this water reaches back as far as the open junction with a live main where steam is flowing a few thousand feet a minute, things begin to happen. Some little disturbance or other starts the ball rolling. The dead water is sucked into the live main, a sudden condensation occurs, the water is shot back into the dead main with all the force of a steam ram and both pipes are wrecked in less than no time. Better leave a drip open on the dead end, or put on a trap.

Pipe Covering

A word about the pipe covering. Put on good magnesia packing and cover it with ready roofing, securing the latter with two copper-wire bands to the yard. The packing bands, of course, go on underneath in their place. The roofing is exceedingly durable, weatherproof, and may be walked on without detriment. Various schemes of sheltering pipes from the weather have been tried, ranging from an inverted V, made of two wooden planks, to sheet-iron roofs bent over the pipes; but the tendency among practical men is to get away from this and cover the pipe all around with some form of asbestos roofing felt.

It is sometimes necessary to run heavy pipe across yards and over tracks. The pipe must pass not less than 21 feet above the rails. It may be hung from wooden poles (in which case the fire risk must be considered), or supported by single 4-inch or 6-inch pipes securely planted in the earth. A successful trestle has uprights of old 6-inch pipe. They are flanged at the bottom and the flanges bolted to a 6x10-inch sleeper. This is sunk 5 feet below the surface of the ground, for a 30-foot trestle, and the earth is well tamped. Diaonals, etc., are of old 2½-inch pipe, flattened at the ends and bolted to the 6-inch pipe.

Pipe Hangers

In the matter of pipe hangers I prefer the old-fashioned blacksmith's pipe clamp of 2½x½-inch flat iron. A clamp is called upon to do so many things besides merely holding up the pipe. For instance: a line of 250 feet of 8-inch pipe was made up with a flanged tee at each end and a flange coupling in the middle. The two halves were hoisted to the hangers separately, and then bolted together. The tees were then seen to be out of square with each other and with the building into which taps were to be run. The pipefitters were only human, as were the men who put on the clamps, and neither had given close thought as to how exact the tees had to be to bring their flanges true with the angle valves leading into the building. I straightened both of those tees by loosening all the clamps in place, setting each one in turn dead true with the tee, and screwing up the hangers one at a time. By the time all the hangers were in alinement, both of the tees had turned to square with the cross lines to which they were to connect.

In taking taps off lines, always set the tee looking up, and come out of the top with an angle valve. This looks like giving too many twists to the column of steam, but it has the practical advantages that the tap does not bind the expansion of the main, and that the water of condensation in the main does not run into the tap and get into the engines.

Valves and Fittings

In selecting valves, choose gate valves when the flow of steam is constant; globe valves when it is intermittent. Both kinds should have shoulders on the stem so that when full open they close against a seat in the stuffing-box gland and allow the gland to be packed with full pressure on. Both valves and seats should be renewable and spare parts kept on hand, or else you cannot renew when the time comes.

Exhaust fittings may all be "standard" weight and crosses freely used, though they are a weak fitting for live steam. Of course pipe bends are advisable in the exhaust if possible, though sharp angles do not seem to make any appreciable trouble with the back pressure. The exhaust main takes all the engines or turbines in the power house, and must also include the feed pump and blower-fan engine exhausts. As it rapidly rises to 10- and 12-inch sizes of pipe and must take in the grease extractor, feed-water heater and connection to the hot well or storage tank, it must be made up principally of flanged fittings and short simple pieces of screwed work. It is all heavy to handle and must be installed in holes and trenches difficult to work in; so make it straight and as simple as possible. All the small exhausts should be led into one sizable bull-head tee connected into the top of the exhaust main. Otherwise you will be pestered to death with impossible reducing fittings, not to mention complication of the design. The exhaust main should be dripped with small gate valves at points where water may collect, just as in the live-steam lines.

Tobin-Bronze for Art Work

It is seldom that a metal used for engineering purposes is employed in the manufacture of art metal goods. Tobin-bronze seems to be one of the exceptions to this statement, as it is now being used for the manufacture of art metal wares of quite a variety. It has been used for a long time for purposes where strength is required.

Mugs, loving-cups, smoking sets, ash receivers, and a line of similar objects are now manufactured of Tobin-bronze, not by the makers of the metal itself, but those who are manufacturers of sterling silver and plated novelties.

The color of Tobin-bronze, when polished, is quite pleasing and resembles 14-karat gold. It is hard, of course, but by careful working it may be spun and stamped the same as any other metal. The hardness is a benefit rather than a detriment, as it shows a good polish to be obtained upon it.—*Brass World.*

Reversing Mechanisms for Machine Tools—II

Mechanisms Controlled in Conjunction with Locking Devices, and Speed Control Secured with Belted and Electrically Operated Drives

BY LUTHER D. BURLINGAME*

It is important to insure the successful working of gear-cutting and similar machines that the many operations should follow one another in proper order and one way of insuring this is to introduce locking devices that will prevent a subsequent operation from starting until the previous one has been completed. This brings us to the consideration of Case VI where the reversing mechanism is to be locked so that it is mechanically impossible for it to operate before the completion of previous operations.

Locking Mechanisms

A device has already been shown in Fig. 8, having in part this feature. The latch *F* positively locks the clutch in place until lifted by the lug on wing *C*. This is controlled by the same movement that later throws the reversing clutch.

Fig. 16 goes a step further in insuring the completion of a previous operation before the next can become operative. It also is used on gear-cutting machines built by the Brown & Sharpe Manufacturing Company. In this construction the feed worm *A* is driven through a clutch *B*, which is automatically disengaged before the indexing commences to operate. It remains disengaged until the indexing has been completed and the indexing mechanism locked in position, after which the feed is engaged by throwing in the clutch *B*. This is accomplished by adding a lever *C* on the rock shaft *G* which controls the indexing. This lever operates the sliding shaft *D* to shift the clutch *B*. Lost motion is provided for in the lever *C* by the screw *E* engaging the button *F* so that there may be sufficient time to lock the index mechanism before the clutch *B* is engaged. There is provision by means of the spring *H* so that if the clutch teeth land on top of each other they will be thrown into engagement as soon as they clear. In a machine requiring an additional operation such as the separating and bringing together of the blank and the cutter at each operation as in a spiral gear-cutting machine, the additional locking mechanism shown in Fig. 17 is used. The constantly rotating shaft *F* is clutched to the gear *G* at each reversal of the carriage, so that the gears *G H* each make half a turn and are then locked in position by disks *I*. On the return movement this operation is repeated, bringing gears *G H* back and locking them in their original position. This mechanism is controlled by the reversing lever *J* through the pinion *K* and the racks *L*. The reversing lever is operated by a rod, which in turn is shifted back and forth by the reversing dog on the slide.

Provision for Lost Motion

The double reversing lever used in this construction as well as that shown in Fig. 16 illustrates a novel way of providing for lost motion. The usual method in such a case is to make the groove *M* in the clutch *N* wide enough to allow for the required lost motion to let the roll *O* pass the head of the plunger *P* before the clutch is released. Such a construction leaves no pressure to hold the clutch teeth in engagement after the lever has commenced to shift, so that there is a possibility of the clutch jarring out and stopping the feed. With the double levers this is prevented, as the lost motion is taken up before the pressure from the spring plunger holding the clutch in place is removed. When it is desired to hold both clutches out of engagement, the lever *Q* is used to slide a wedge *R* between lugs *S* on the lever *J*.

Passing the Normal Reversing Point

Case VII, where provision is made for passing the normal reversing point, has already been shown in Figs. 5 and 6. Another simple method is shown in Fig. 18, where the lever *A* is hinged and can be swung out of the path of the dogs. The desirability of doing this is especially felt in such machines as cylindrical grinding machines, where it is desired to run by the dogs to caliper or change the work, true the wheel, etc.

If the dogs are left carelessly out of the path of the reversing lever, damage might result when the machine is again started. One way devised to avoid this

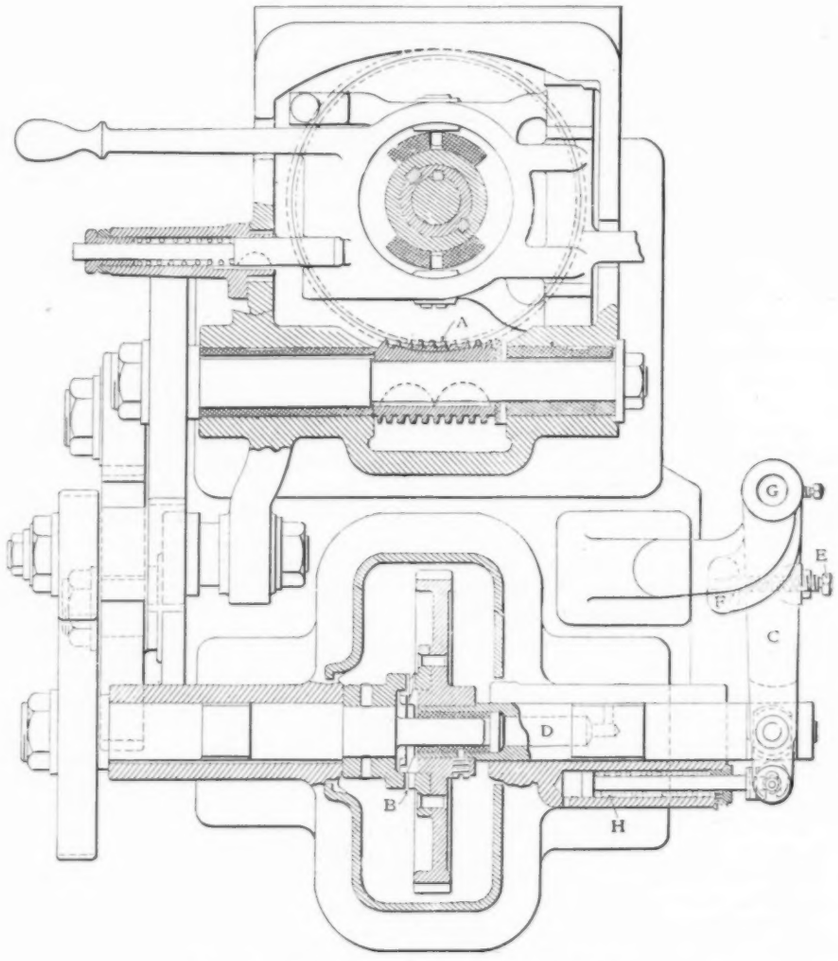


FIG. 16. REVERSING AND LOCKING MECHANISM

*Chief draftsman, Brown & Sharpe Manufacturing Company.

danger is to hinge the dogs so that they will drop by gravity when released. The dogs shown in Fig. 19 are hinged but in this case each has a spring detent shown at *x* in Fig. 19A, to hold it raised. There is, however, a tail piece *U* provided on the dog that will bring it down into the operative position when it passes the lever *V* in returning, thus preventing accident. These dogs are shown engaging the teeth of a fine-tooth rack *W*, thus preventing the possibility of slipping. They can be readily disengaged and adjusted to a new position, when desired.

Stopping at the Reversing Point

Figs. 19, 19B, 19C and 19D further illustrate Case VIII, where means are provided for automatically stopping when reaching the normal reversing point.

By means of the auxiliary levers *A A'* a stop *B* may be brought into the path of projections *C* on the reversing plungers. This stop *B* can be set at any time during the travel but will not stop the table until the end of the stroke, when it will hold the clutch inoperative until, at the will of the operator, by means of the same lever it can be made to complete the reversal.

Speed Modification

Case IX, where a change of speed or a dwell at or near the limit of travel is to be obtained, has already been described, this being a feature of Fig. 11, where, in an automatic screw machine, the tool is quickly brought away from the work to allow for indexing the turret and as quickly advanced again after the indexing to the point where the next cut begins. Such a device is of special advantage for such a purpose where it is important that every second of time may be economized. It is also a feature of planer reverses, where, in order to accomplish the reversing with the expenditure of less power, also to be able to run at higher speeds, auxiliary devices are used to advantage to modify the speed. One of these is shown in the American Machinist at page 1358, Vol. 26. It is for accumulating power in a fly-wheel and utilizing it at the moment of reversal, thus reducing the belt strain.

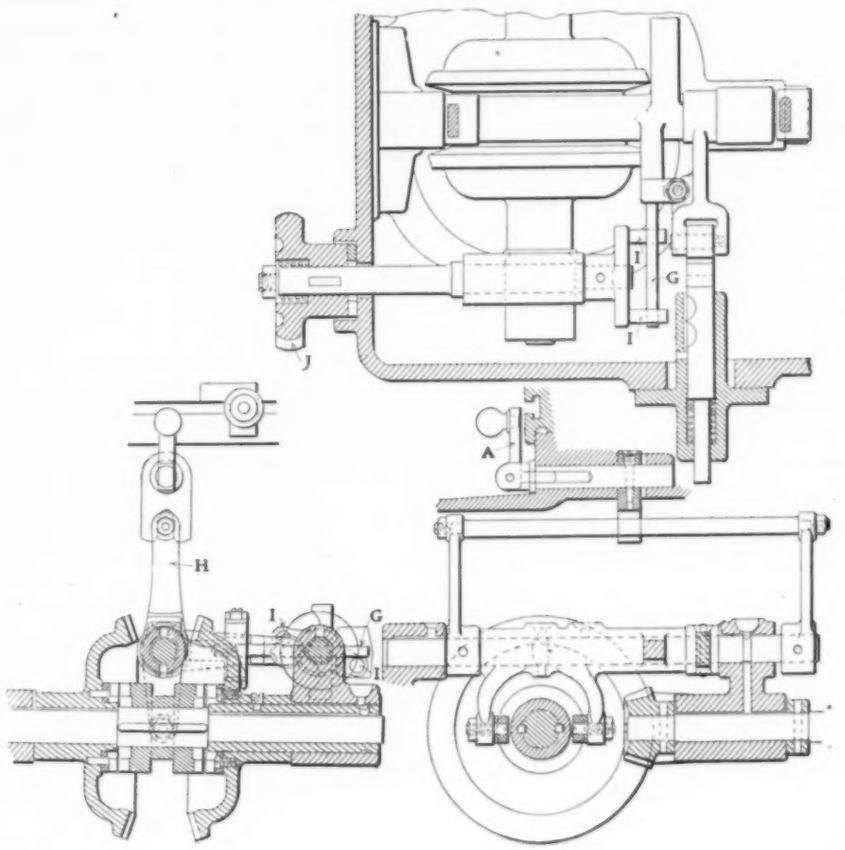


FIG. 18. CONSTRUCTION WITH HINGED LEVER TO CLEAR REVERSING DOGS

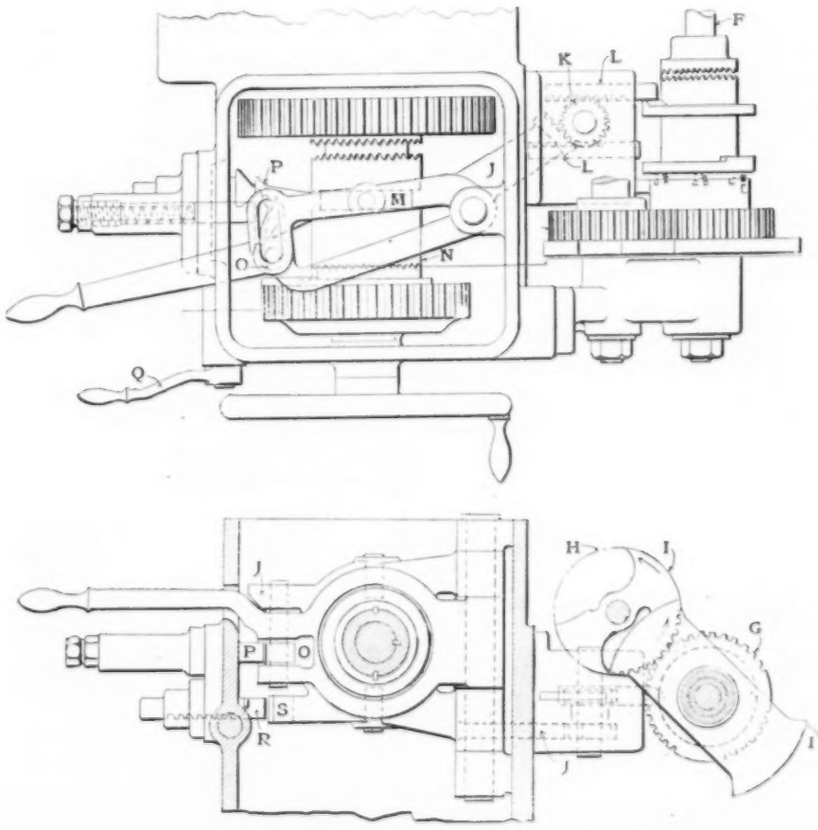


FIG. 17. REVERSING AND LOCKING MECHANISM

Motor-driven Planer Reverse

Much thought has also been given to the reversal of electrically driven planers, one design being shown in the American Machinist at page 456, Vol. 28, Part 2, in which the speeds are controlled by electric switches. Another is shown in the Hagman patent No. 792,024, where the planer has a constant-speed drive in one direction suitable for the use of an electric motor, and the varying speeds and reverse are effected through gearing controlled by clutches operated by pneumatic pressure. As there are two reverse speeds provided, the reverse can be shifted to

the slower of the two on the return and as soon as under way, the faster can be thrown in and remain until nearing the completion of the return movement, when the slower speed is made to again become operative, so that the platen can be reversed without undue shock.

Mechanical Control for Planers

A method of mechanical control for a planer reverse, to accomplish a similar result, is shown in Fig. 20, in which, in addition to the regular pulleys for the slow advance and quick return, there is an auxiliary pulley to be thrown into action to modify the speed at the times of reversal, to ease off, so to speak, thus avoiding shock and reducing the power required. This is accomplished by throwing the auxiliary drive into operation when reversing for the quick return at such a speed as is practicable and then accelerating the speed by shifting to the higher speed of the regular quick return. On nearing the completion of the return movement, the auxiliary drive is again brought into operation, slowing down at the last moment to a safe point of reversal before shifting the belt to the pulley for the slower advance feed. This is shown and described in the Chandler patent No. 826,476.

A method that has been used for giving a dwell at the end of travel where a rack is used for feeding is to allow a limited sliding movement to the rack equal to the extent of dwell required, so that, at each reversal, the rack slides sufficiently to take up this lost motion before starting the feed in the opposite direction. This is shown in Fig. 21.

Hand Control of Reversing Devices

Case X, providing means for controlling and operating by hand, is illustrated in many of the examples already shown, as in Fig. 3 where the pin *I* engages the pin *G* and by swinging the pin *J* to the hole *K* will hold the clutch out of engagement. Special attention, however, is called to Fig. 18, which shows a simple, effective reversing mechanism illustrating in addition to this feature many of those already described. It is used on the No. 2 surface grinder built by the Brown & Sharpe Manufacturing Company. It has a bevel-gear clutch reverse operated through dogs and levers with a spring plunger to effect the reversal of the lever. There is an arm *G* on the reversing lever *H*, which is engaged by two pins *I* operated from the front of the machine by a knob *J*. When the knob is turned so as to bring these pins into the position shown, the clutch is held in a central position and the feed is inoperative. When turned, so as to stand in a vertical position, they allow a free operation of the automatic reverse.

Clutch Layout

Fig. 22 shows the method of platting a reversing clutch so as to have sufficient lost motion to allow the roll to pass the head of the plunger in each direction before the clutch is withdrawn, also to show the relative location of the parts at each point of change. In making the layout it is a help to use different colors to show the

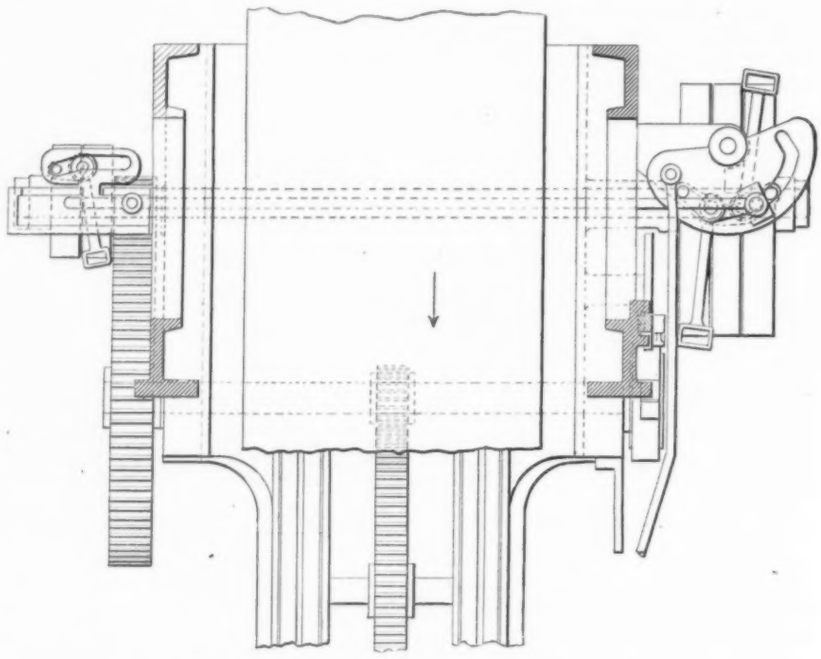


FIG. 20. AUXILIARY DRIVE FOR PLANER REVERSE

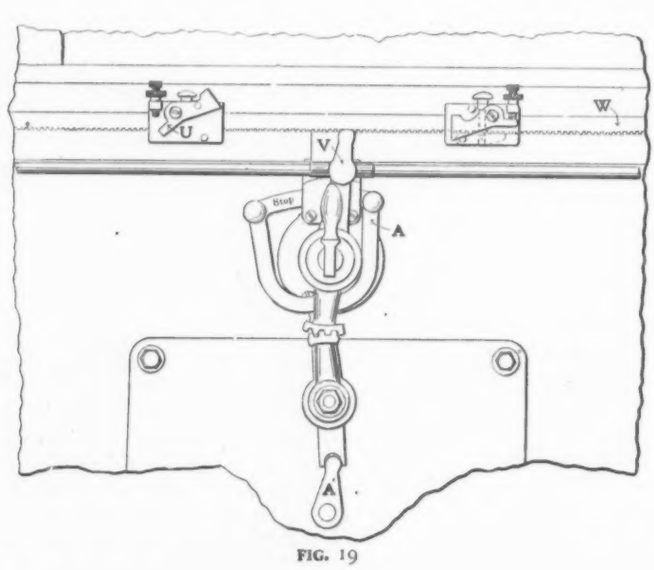


FIG. 19

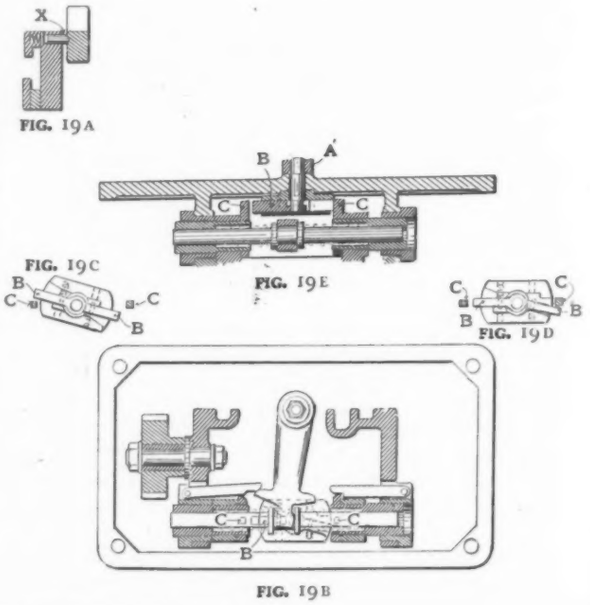


FIG. 19A

FIG. 19E

FIG. 19C

FIG. 19D

FIG. 19B

MECHANISM FOR STOPPING PLATEN AT REVERSING POINT

clutches, the roll and the plunger, one color being used to indicate the different parts in each position.

New Applications of Case-hardening

By Phillip C. Osterman

The drawbacks of the case-hardening processes heretofore in use have seriously interfered with the advancement of low-carbon steel to the place of importance which it was destined to occupy in the industrial world. Case-hardening is an art of steel treatment, which due to the unscientific method of the old-time process, is decidedly in its infancy of application. The instances, in which the application of case-hardening or cementation is preëminently suitable are limitless. There is hardly a manufactory in existence in which one versed in the art could not point out many pounds—often many tons of parts which should be case-hardened either for economic reasons or for reasons of superiority, and very frequently, both.

A great deal of case-hardening has been done for colors—the color is really a trivial matter and deserving of little consideration; the object of prime importance being the proper combination of tough core and hard shell or "case." The color is no criterion of proper case-hardening; in fact a great many pieces purporting by their color to be case-hardened are given their mottled appearance by some chemical preparation.

No Uniform Results

It might be well to point out here some of the causes of non-uniformity of results attained by the methods generally pursued in this art of steel treatment. It is assumed that everyone is familiar with the old methods of case-hardening; namely that of packing the articles in a carbonaceous material, such as bone, charred leather, etc., in iron boxes.

Let us consider a lot of screws or similar parts so packed, the usual number of test wires are inserted to aid in determining the proper length of time to keep the articles under heat to attain the desired depth of carbonization. A test wire near the outer edge of the box is withdrawn

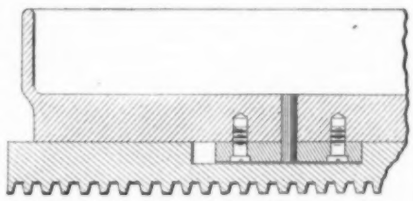


FIG. 21. SLIDING RACK FOR PERMITTING DWELL OF TABLE

and found to have just reached the carbonizing temperature, that is that temperature at which the articles packed begin to absorb carbon. If now a test wire nearer the center be withdrawn, it will be found to have not nearly reached the carbonizing temperature, as a test wire right in the center of the box cannot reach the proper temperature until long after those around the outer edge.

It follows then that if the box is kept under heat until the innermost articles have attained the desired depth of carbonization, the outer ones will have been carbonized too deep, or if the box were to be removed for quenching when the outer articles are carbonized to the desired depth, the inner ones would be found to have absorbed little or no carbon. Thus, it will be seen that uniform results by this process are well nigh, if not utterly impossible.

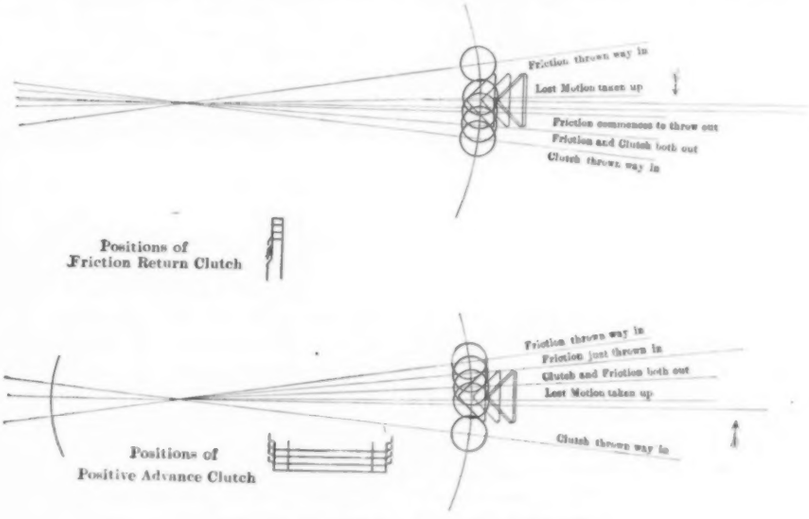


FIG. 22. PLOTTING A REVERSING CLUTCH

Effect of the Packing

In speaking to several gentlemen of considerable experience in case-hardening, the writer ventured that by the old method of packing in boxes, the articles being carbonized constituted on an average only 50 per cent. of the bulk of material being heated; and he was told by all that their experience warranted the statement that the articles packed averaged only 33 per cent. of the entire charge of a case-hardening furnace.

So it will be seen that this old method is very wasteful of heat; also that *all* packing materials which have been used were non-conductors of heat—a pretty state of affairs, to surround the articles with an insulating material—so to speak—no wonder you hear of 18 to 24 hours and more for a carbonizing operation.

The proper quenching of the carbonized material has heretofore received very little consideration. The greatest care might be taken in packing, heating, etc., to attain the best results possible by the old method, and all this precaution set to nought by improper quenching. Frequently the whole charge is simply dumped into a bath, in which case some pieces which become separated from the bulk are hardened; others are hardened only in spots, and still others, due to being buried under a mass of packing material, will not harden at all, as the liquid of the bath cannot come in contact with them.

Sifting the packing material from the articles is often resorted to before quenching, but of course the pieces which remain bunched together will retain the heat longer than those on the outer edge of the bulk, which become separated and cool down considerably faster.

Screws, Bolts and Shafts

Among the parts which should always be case-hardened, are screws, nuts and bolts of all kinds, whether machine screws or wood screws, and particularly those screws and bolts which are subjected to a shearing strain. It is very singular that hardened screws are so little used when the advantages are so apparent. This, no doubt is directly attributable to the uncertain results obtained by the various processes of case-hardening heretofore in use.

Would it not be a boon to have the corners of square and hexagon head screws remain sharp so that the wrench could not slip, and in the case of screws with slotted heads, if they were hardened would you ever hear "Damn it, there goes the slot?"

A hardened screw can be more easily tightened than a soft one, due to the open surface of the latter cutting and being easily cut in, and further because of its open pores, a soft screw will rust very much sooner than a hardened screw.

Shafts have been case-hardened in quantity *"straight."* Think of the enormous saving in power, space and material made possible by the use of case-hardened shafts, especially in printing presses, weaving, spinning, and all high-speed machines. Every mechanic knows that a hardened shaft, because of its closed

surface, even if not ground, will turn easier than a soft one, and a hardened shaft to transmit the same power as a soft one, can be of smaller diameter; thus effecting a saving in space, material, and a further saving in power because of reduced friction.

With hardened shafts of smaller diameter, higher speeds could be attained. Since the use of case-hardened shafts on a machine would allow of a reduction in the weight of the machine generally, the cost of the machine in most cases need not be higher than if soft shafts were used, but the machine would be given a longer lease of life.

Boring Bars and Pneumatic Tools

The employment of low-carbon steel for mandrels would be an ideal procedure. Just consider the enormous outlay represented in mandrels of high-carbon steel, of which I have seen tons and tons in use in one establishment.

As carbonizing only, or in other words, transforming the outer surface into high-carbon steels, materially stiffens a shaft, I would recommend it for boring bars, hardening only the pilot as far as it enters the hollow spindle.

Pneumatic Tools, Gears and Dies

Further application of case-hardening is recommended for pneumatic tools, not only to lengthen the life of the moving parts, but also to enable the many small holes and passages to better withstand corrosion caused by the moisture which collects in pneumatic tools. This is a problem which is out of the question by the packing method, but is being done in a furnace for carbonizing with gas. Among other parts which would present difficulties by the old method, are gears. These could be so handled by the new process as to expose only the teeth to the carbonizing action; this when quenching avoids trouble from warping, as the entire body of the gear would remain soft.

It is a well known fact that the life of drop-forge dies will be more than doubled if used on steel low enough in carbon to be suitable for case-hardening instead of on even a moderately high-carbon steel.

For plyers of all sorts, and kindred articles, it would be strongly advisable to use low-carbon steel, case-hardening portions, or the whole plyers, and in many cases it would be practical to case-harden plyers after they have been assembled.

The prices at which plyers, tongs, etc., must usually be sold, necessitate the employment of a cheaper grade of high-carbon steel, and consequently anything but satisfactory results are obtained in the hardening. This steel, as is well known, requires greater care in heating, etc., and though comparatively cheap, is not so cheap as a low-carbon steel, which latter notwithstanding much more careless handling will give better results in the finished product.

Carbonize for Stiffness

There are many parts made of high-carbon steel which, it may not be necessary or desirable to harden; but why not make these parts of low-carbon steel and carbonize to the necessary depth to get the desired stiffness. Sleeves or casings, for cheaper roller bearings, on which the cost would not warrant grinding, could be formed-up cold to correct size, easier of low-carbon steel than if made of high-carbon steel, as the latter is much more springy. After forming-up, the sleeves could be carbonized to obtain the necessary stiffness, and then hardened if desired.

Another field in which steel, suitable for case-hardening should enter is in dies for paper perforation, and especially knives for paper cutting. These knives are made in a great variety of lengths, frequently many feet long, and were low-carbon steel used, and case-hardened for only a narrow width from the cutting edge, all the trouble of peening straight and the attendant danger of cracking where high-carbon steel is employed, would be avoided.

Case-hardened Nails

While dwelling on the various applications of case-hardening—who ever heard of case-hardened nails? Surely, no one will dispute the superiority of nails so treated, as compared to ordinary nails, especially where they are to be driven into hard wood, cement, or into a brick wall. By the old method this was so impractical, owing to the expense as to be not even dreamed of, but if it can be shown to be both practical and profitable to apply case-hardening to nails, with a furnace that uses gas for carbonizing, thus reducing the cost over one half, is it not the duty of everyone responsible for the progress of anything mechanical to see to it that this art of steel treatment is applied to the hundreds and thousands of parts which, by their nature or function require it ever so much more than nails.

Large consumers of low-carbon steel have been able to get it made up to their specifications, but the small users have had to accept what they could get. The advent of a new process of case-hardening by which predetermined uniform results can be guaranteed will have the tendency to urge the steel makers to produce a uniform grade of low-carbon steel or soft basic stock suitable for case-hardening as one of their regular or standard outputs. They cannot then as in the past hide the faults of their steel back of the uncertain results of old case-hardening methods.

The writer has had occasion to witness the practical demonstration of many of the foregoing applications of case-hardening, by a new process, which entirely eliminates all the chances of failure of old case-hardening methods.

Proportions and Loads of Roller Bearings

The practice of the Standard Machinery Company, Providence, R. I., regarding the Mossberg roller bearing is interesting as being the result of long experience, as this bearing was very early in the field. One of the first applications was in a rolling mill for the Watson & Newell Company, manufacturing jewelers, of Attleboro, Mass., the bearing being 3 inches in diameter and 5 inches long.

The underlying principle in the construction of the Mossberg bearing is that of distributing the load on as many rollers as possible; with this in view the rollers are made small in diameter. It is assumed that the rollers interposed between the journal and box surface form only a line contact, and consequently a small roller will carry as heavy a load as a large one.

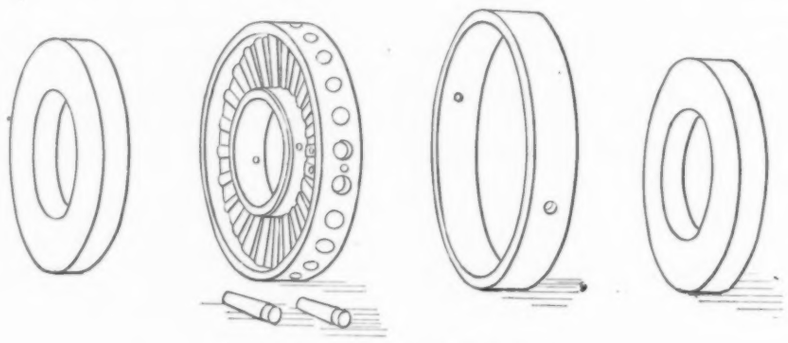


FIG. 1. MOSSBERG THRUST BEARING

After making experiments and noting practical results along these lines for several years, the following table has been adopted as the standard. In this table the projected area of journal is considered as the bearing surface.

It will be seen from this table that 20 is the smallest number of rollers used in the bearings, while the projected area of journals is carried on about seven rollers, and in larger bearings more. In rolling-mill practice the surface speed of the journal is somewhat less, but the load very largely exceeds figures given in the above table, instances being known where the pressure is as high as 10,000 pounds

per square inch of projected area of journal.

Their experience indicates that the rollers should be made of tool steel not too high in carbon and should not be of too high temper, an ordinary spring temper being best. Care should be taken that the journal shaft of the box is not made above the medium spring temper. The box, however, should be made of high carbon steel and tempered as hard as possible.

Diam. of Journal. Inches.	Diam. Rolls. Inches.	No. of Rolls.	Safe Load on Journals.
2	¾	20	3,500
2½	¾	22	7,000
3	⅞	22	13,000
4	1	24	24,000
5	1	24	37,000
6	1¼	24	50,000
7	1¼	22	70,000
8	1⅜	22	90,000
9	1	24	115,000
10	1¾	26	175,000
15	1⅞	28	250,000
18	1⅞	32	325,000
20	1⅞	34	400,000
24	1¼	38	576,000

The cages are made of a good tough bronze metal similar to gun metal, but of a special composition. It is also essential that the grooves be made parallel with the axis of rotation, clearance being left for the rollers; the cage merely acting as a guide.

Thrust Bearings

Thrust bearings, to take the lateral thrust of a rotating shaft, must have conical rollers in order to secure perfect rolling contact and must be placed radially around the axis of rotation, that is, the apex of the cones must terminate at the center, and the angles of the cones should not be over 6 or 7 degrees. If the angles of the rollers are larger than this, the outward thrust in radial direction will be excessive and cause the destruction of the outer ends of the rollers.

The two outer collars form the rolling surface for the bearing, one being fixed stationary and the other fastened to the shaft and revolved with it. The inner surface of these two collars is made conical to correspond with the angle of rollers in bearing. The ring fits tightly over the bearing and serves to hold the rollers in position, acting merely as a guide. The collars, as well as the ring, are made of high-carbon tool steel, are made very hard and then ground. The rollers are made of medium-carbon steel and spring temper.

The following table gives data relative to pressure on thrust bearings:

The third case, which is known as universal automobile bearing, is a combination conical bearing made with solid cage. The principles of manufacture and the material used in these bearings are the same as in the thrust bearings. It is also possible to make this new bearing very light, which makes it well adapted for automobile work.

Diam. of Shaft.		No. of Rolls.	Area of Bearing Plate.	Safe Pressure on Bearing Speed 50 Rev.	Speed 100 Rev.
2⅛—2¼	5	30	10.137	19,000	9,500
3⅛—3¼	8	30	20.862	40,000	20,000
4⅛—4¼	10⅝	30	35.097	70,000	35,000
5⅛—5¼	12⅝	30	54.2	108,000	56,000
6⅛—6¼	14¾	30	78.017	125,000	62,000
8⅛—8½	18¾	32	132.06	200,000	100,000
9⅛—9½	20½	32	162.98	300,000	150,000

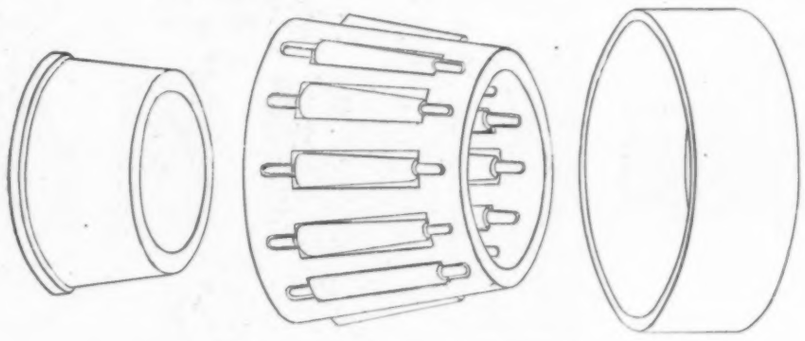


FIG. 2. MOSSBERG AUTOMOBILE BEARING

Accurate Scale Measurements

By W. S. Romell

Since reading your review on measuring instruments, the wish has been strong with me to see some discussion on the use of the steel rule for close measurements. The article by Clinton Alvord, on page 836, starts but does not finish the subject. I have known for many years that the steel rule may be used for much closer measurements than are generally supposed possible. Scales made by reputable makers today are usually so accurate that no means are at hand in the common shops for finding their errors. Granting this degree of accuracy, the question will arise as to the possibilities of using them for close measurements. The term "close measurements," of course, is comparative. In this case we will consider 0.001 inch as a permissible variation in measurement, and will say that the steel rule is available for measuring to this degree of accuracy, where the object measured has sharp, clean corners.

In questioning the best machinists and tool makers as to how closely a skilled mechanic should measure with a good steel scale, the answers received have varied all the way from 1/64 inch to the correct answer, namely, from 0.001 to 0.002 inch. Mr. Alvord speaks of the possibility of estimating a fraction of a division of a scale. I enjoyed the acquaintance of a mechanic some years ago who could correctly estimate a fraction of 1/32 inch or 1/64 inch on a good steel rule to within 0.001 inch nine times out of ten. This, of course, required a combination of good eyes, good judgment and training, which stood him in very good stead for rapid work. I have known but one other person who could be said to equal him, and can say from my observation that for most men the attempt to measure within 0.001 inch with a steel rule is a loss of time.

My work requires the taking of many measurements in the course of a day, most of which should be decided within from 0.001 to 0.005 inch. My practice for the last 14 years has been to carry some sort of beam caliper; if provided with a vernier reading to 0.010 inch, or thereabouts, so much the better. As my work takes me over a large amount of floor space, the carrying of micrometers for a variety of measurements from a few thousandths of an inch to 5 or 6 inches would be out of the question. I find a 6-inch beam caliper with a vernier reading to 0.010 inch for both inside and outside measurements is by all odds the most convenient tool that has yet come to my notice. Giving it all kinds of hard use, one instrument will last me two or three years. When it begins to lose its accuracy from wear, it is set aside and a new one put in my pocket. Not only would micrometers to cover this variety of sizes be inconvenient to carry, but the micrometer is too slow of movement to suit my purpose. The beam caliper is instantly changed from nothing to its full capacity. The vernier makes reading to 0.001 inch as quick and as easy as reading to 1/64 inch would be without it. With a vernier reading to 0.010 inch, any size between the lines is easily estimated within 0.001 to 0.002 inch.

Mr. Alvord speaks of the difficulty he encountered in convincing his foreman that such measurements as he is describing could be taken with a steel rule. This is very readily understood. The method which I pursue to convince others of the possibility of deciding a measurement within 0.001 inch with a steel scale is to take an outside micrometer and open it at random with the graduated side down. Then measure the opening between the measuring points with the rule, record the size on a piece of paper and turn the micrometer over to read the size as indicated by the graduations.

Some Contrivances from Sparrow's Point

A Tool for Packing Condenser Tubes—A Thermit Weld—Paying off Quickly—Kerosene-burning Heaters for Shrink Fits

BY H. J. KENNEDY

Some of the knick-knacks contained herein were picked up at the marine department of the Maryland Steel Company, Sparrow's Point, Md., and some come from elsewhere in the works. Since this concern does not run a manufacturing machine shop, one does not expect to find there numerous jigs and special fixtures; from time to time, however, as special requirements arise, such devices are constructed to meet them, and some of them make their appearance in the columns of the AMERICAN MACHINIST.

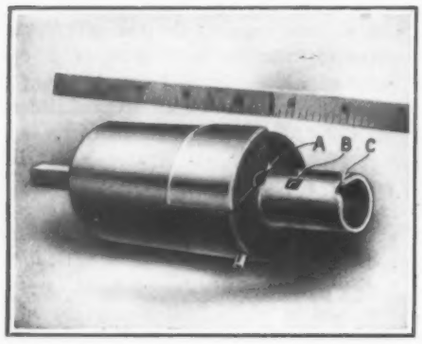


FIG. 1. TOOL FOR PACKING CONDENSER TUBES

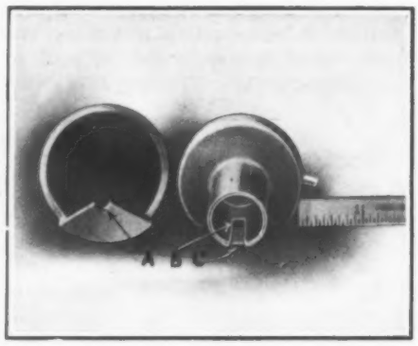


FIG. 2. THE CONDENSER-PACKING TOOL TAKEN APART

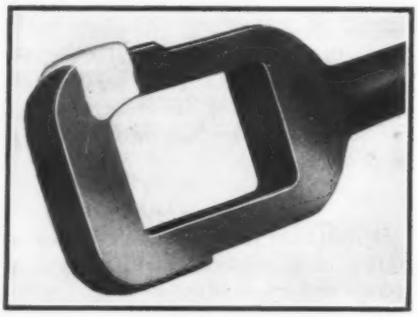


FIG. 5. AFTER CLEANING UP

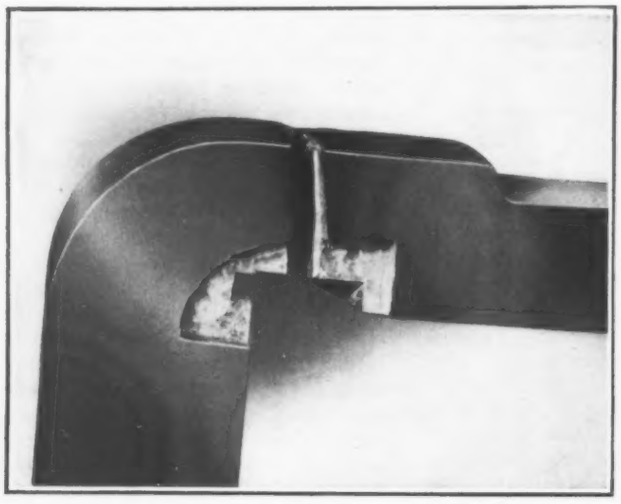


FIG. 3. THE PIECES PREPARED FOR WELDING

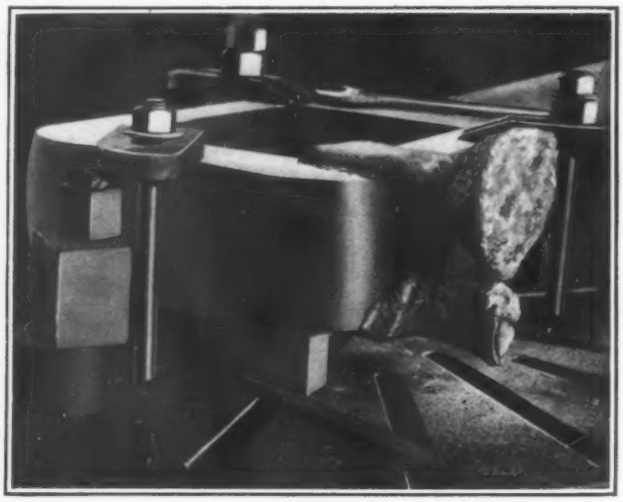


FIG. 4. THE WELD IN THE ROUGH

Figs. 1 and 2 show a tool used in one of the machine shops, for putting packing around condenser tubes. In the first figure the tool is shown with the two parts put together, and in the second they are shown separate. It consists of a cylindrical magazine for containing the packing, a cover for the magazine upon which is formed a tube capable of fitting around the condenser tube and of entering into the hole in the tube sheet. The packing comes out of the box through the hole *A* and goes into the tube through the hole *B*. The wall of the tube between *B* and *C* is very thin, though its surface is uninterrupted on the outside; on the inside a channel is formed in the thickness of the metal, permitting the packing to run to the notch *C* and out into the packing recess in the tube sheet, as the tool is turned by means of the square shank, seen at the left of Fig. 1. The two parts are compelled to turn together by the sectorial joint plainly shown in the cuts.

A THERMIT WELD

A successful weld by means of Thermit, made on a broken connecting-rod from one of the old walking-beam Bessemer blowing engines (54- and 84x60-inch double vertical) is shown in the half-tones Figs. 3, 4 and 5. The crank-pin bearing was 10 inches diameter by 9 inches long; the maximum thickness of the metal perpendicular to the line of centers of the rod was 4¼ inches, and the thickness of the end was 4½ inches. Fig. 3 shows the joint as prepared for the weld, and Fig. 4 shows the end of the rod after the mold was broken away and before the gates were removed. Fig. 5 is a view showing welded joint after cleaning up.

PAYING DONE QUICKLY

An expeditious method of paying off is in use at the marine department, enabling 2000 men to be paid off in a quarter of an hour. The shipyard, which is located on the west shore of the peninsula, is surrounded by a high fence; it is complete in itself, with the exception of pattern shop and foundry, and has included among its output steamships, both freight and passenger, steamboats, tugs, dredges, yachts, lighters, etc. The yard where the

big steel dry docks were built is separate from this one.

To each employee in the yard is assigned a number, which is indicated to him by a ticket handed him when he enters the company's employ. These numbers are divided up according to trades and shops; thus numbers 100 to 300 represent tool-shed men; 300 to 600, fitters; 600 to 750, assembly men; 800 to 825, stockyard, and so on with painters, cabinetmakers, etc. The men's wages, which are paid to them every Saturday at quitting time, have been already counted out and sealed up in envelops. There are four entrances to the gate house, each having a narrow passage alongside of which is a little office, communicating therewith by means of a wicket. Over each door are posted the lowest and highest numbers of the men who are to go through that door; when the whistle blows for quitting, the men get into line inside the gates, dividing up and arranging themselves according to numbers, and, when the word is given, the lines pass through, each man calling out his number as he approaches the wicket.

A Good Motto

In passing the marine-department office building which adjoins the gate house, I am reminded of the excellent motto which is worked into its mural decoration; ever before the engineers and draftsmen, it is apt to become indelibly impressed upon their minds: "Observe, Compare, Reflect, Record; Without Haste, Without Delay, With Perfect System." I have, however, heard one engineer remark that *his* motto was just one word: "Hustle!"

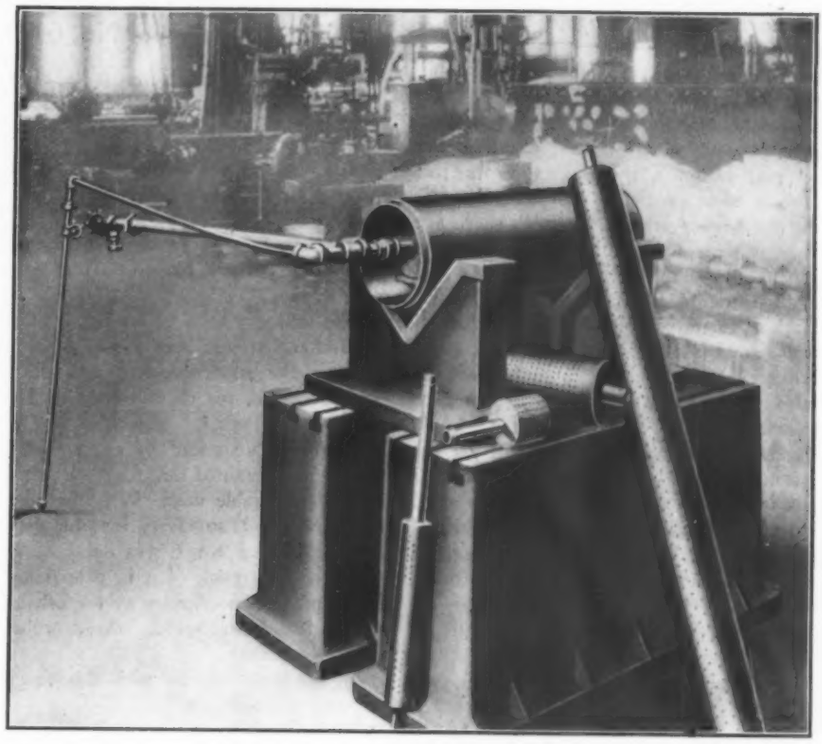


FIG. 7. KEROSENE BURNER FOR SHRINKAGE HEATS

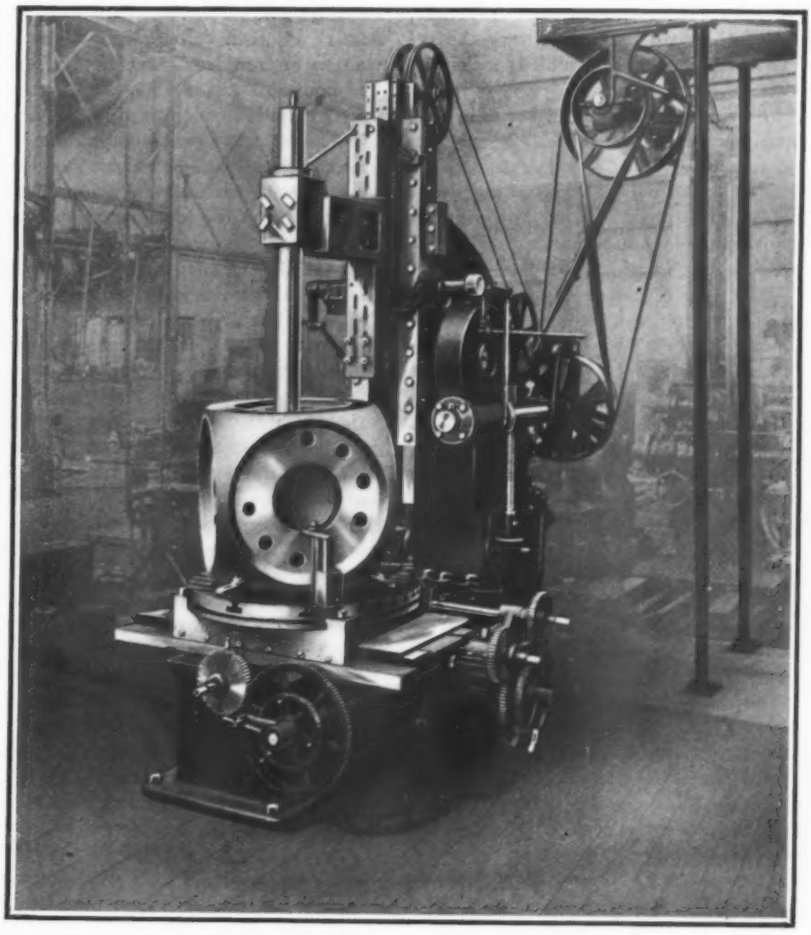


FIG. 6. A JOB WHICH TAXED THE LARGE SLOTTER

Key-seating Hubs Beyond the Size of the Machine

Fig. 6 shows how a large job which taxed the facilities of the shop was done. It was the key-seating of large propeller hubs, such as were used for the Atlantic transport liner "Maine," which had a propeller 16 feet 6 inches diameter over the four manganese-bronze blades bolted to a cast-iron hub 3 feet long in the direction of the axis. The biggest slotter in the shop was only about 36 inches, and so an extra block was bolted to the ram; to this and the regular tool block was bolted a parallel strip, carrying an extension tool block as shown.

Kerosene Burners for Cranks, etc.

Fig. 7 shows a rig used in the marine-department machine shop (known as No. 2) for heating cranks for shrinking them on the shafts. In the picture it is shown placed inside of a sleeve. The fuel used is a good grade of kerosene, which is kept in a tank in the ground outside the shop, shown in Fig. 8. *A* is a pipe conveying

compressed air to the top of the kerosene in the tank, *B* is the pipe leading the kerosene into the shop, *C* is the filling plug. The burner is supplied with the fuel through a ¼-inch pipe and with air at 100 pounds pressure through a 1-inch pipe, beyond which, at the junction, the oil pipe passes a short distance, the oil and air mixing together just before reaching the burner proper, of which there are various sizes according to the size of the job; some of these are shown on and against the blocks supporting the outfit. Each of them consists of a piece of standard wrought-iron pipe drilled with small holes all over except at and near the ends; the holes are spaced about 1 inch apart and were drilled with 1/16-inch drills and then closed in a little by the hammer. Originally gasolene was used for fuel, and the ends of the burner were then screwed in; however, later insurance requirements prohibited the keeping of gasolene, and kerosene was substituted, with the result that explosions in the burner began to occur, blowing out the

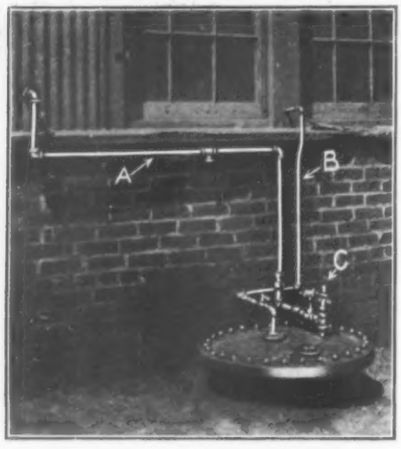


FIG. 8. SUPPLY TANK FOR KEROSENE BURNER

ends. The reason for this was that the deposit from the kerosene effectually blocked up the little holes, leaving insufficient outlet for the heated gases. Thus the safe fluid gave explosions when the dangerous one did not. Now the ends are made of mild steel or malleable iron about 1¼ inches thick and are welded in, and the holes are cleaned out at intervals.

It is reported that at present Brazilian imports show a special demand in the way of machinery of all kinds and electrical appliances. The demand in these lines is greatly on the increase, the imports of Brazil for the year just closed showing an increase of about 25 per cent. over those of the year before. The Brazilian market is one of permanency, and the manufacturer securing trade there can easily hold it with the proper kind of attention.

Echoes from the Oil Country—The Foreman of No. 6

By W. Osborne

"You couldn't use another fellow in No. 6 could you?" asked the foreman of the lower shop of the superintendent. "The foreman there was so well pleased with Bailey that I would like to let him have a mate to him."

This letting a man go to No. 6 instead of discharging him was a sort of a joke between the superintendent and the various foremen, for the foreman of No. 6 was working several men who had been pronounced "no good" by other foremen, while he maintained that they were among his most valuable men. Why this should be so was not so clear, for the department known as No. 6 was doing as good work, and as much of it in proportion to the number of workmen, as the other departments from which these rejected workmen came.

"What is the matter with this one that he does not suit you?"

"It is hard to say what is the matter with him. He seems to want to get along and is a hard worker and willing to tackle anything he is told to, but somehow he does not get there. He is so honest and cheerful that I don't like to drop him; yet I feel that I am not getting the results from him that I should. It looks like a case of No. 6 or out."

No. 6 was not so crowded but that there was room for one more, and Porter was told to report there.

As the superintendent walked into No. 6 one day, he chanced to think of the change and stopped by the foreman. "How do you get along with Porter?"

The foreman looked up with a broad smile. "I don't want to knock any of my brother foremen, but the one who let Porter get away from him made the mistake of his life. If those that he has left are so much better that Porter could not keep up, they must be wonders. The records of that department must make those of mine look sick. I have him on the same kind of work he was on down there and he is all right. He caught right on without the least bit of trouble. If you have any more of that kind around, send them along."

"I am glad to hear that you are suited with him and that he is making good."

The superintendent passed on, but he kept on thinking about the matter. Why was it that this foreman could get good results from men when other foremen could not? Viewed in the light of general education, experience in shop methods and length of service as a foreman, he did not have any advantage, but rather the reverse. Beyond that acquired in the public schools his education had been self education. He had not worked in many shops, was in his first position as foreman, and had been at it for a shorter time than any other foreman in the establishment. The superintendent knew that it was not uncommon to find that a man who had been considered very good in one shop was not getting along in another one, but he also knew that the reverse was also often true. Such cases he had attributed to the individuality and adaptability of the men more than to anything else. Perhaps there was more in it than that after all.

"Are the holes to be laid out and drilled on the large end of these pieces or on the small end?" The man came up to the foreman of the east shop as the superintendent approached.

"You will find it all on the blue print which I gave you to work by. Let me see it a minute." The blue print was handed to him, and after glancing at it he remarked, "If you had looked at it, you would not have needed to have come to me."

"Which side did you say to drill?" persisted the man.

"See here," exclaimed the foreman, pointing to the blue print; "the holes go in the small end just as this shows. These prints show just what we want, and we have them for that very purpose. You will have to stop wasting time running around the shop to find out such things. Look on the blue print. Mind that now and shove them along, for we will be waiting on some of them the first thing you know."

The man had taken out a note-book and with a stub of a pencil jotted something down. "The holes in this piece are drilled in the small end of the piece," he remarked as he started to move away.

The foreman turned to the superintendent. "All my men are not as dumb as that one, thank the Lord." The superintendent wondered how he would get along in No. 6.

The foreman of No. 6 was starting a man on a new job. "Here is a piece, and this blue print tells you a lot about it. If you don't just understand the thing, let me know and I will help you. I can understand one lots better when I have the piece to look at at the same time. Don't be afraid to come back if you get mixed up."

The foreman turned to a man who was fastening some work to the drill-press table. "No; do it this way," and he slipped the bolts in where they belonged. "Keep your bolts in close to the work and keep the heel of your clamps down level with the work." The man had the idea demonstrated to him at the same time that it was told, and he understood it.

Therein lay the secret of the whole matter. The foreman of No. 6 found it easier to show his men what he wanted while he was telling them than he did to find language that he could trust to do the entire job of instructing. Many men un-

derstand showing much better than they do telling. Such men naturally get along better with him than they did with a foreman who did more telling and less showing. He also had a habit of giving a man a sample of the work wherever possible, as well as giving him the blue print. "It is so hard for me to get a blue print through my head the first time I see it that I try to make it as easy for the men as I can. It's awful easy to make mistakes anyhow, and I want to cut out all the chances that I can," was his explanation.

The foreman and the men in No. 6 seemed to fit one another.

Applying a Quick Return Motion to a Horizontal Milling Machine

By W. G. Dunkley

The accompanying illustrations show how an old horizontal milling machine of the planer type was altered to obtain a quick return motion to the table instead of having to bring it back by hand at the end of each cut.

It will be noticed that an epicyclic train is used to obtain the slow-feed motion; although this is a subject that has been practically exhausted in your paper quite recently, still the examples given have been more to show how to work their gear ratios out than to give practical examples of their use.

Fig. 1 shows the machine as it was originally designed. The feed cone pulley 1 ran in one direction only and drove the feed shaft 2 through the clutch 3, thence through the right-hand worm and worm wheel 4 to the screw 5. At the end of the cut the clutch was released by means of the hand lever 7, and the table was brought back by means of a cross handle on the squared end 6 of the feed shaft.

Fig. 2 shows alterations made, and it will be seen that an epicyclic train has been introduced. Now, using the epicyclic train, we obtain a slow speed to the feed shaft 2 for the feed. The wheel *B*, which is keyed to the feed shaft 2, can be clutched to the cone pulley. We can thus drive direct from the cone pulley to the feed shaft, obtaining a quick speed in the opposite direction to that for the feed, for the quick return of the table.

It will be observed that the feed shaft is driven at the same speed and in the same direction for the quick return as for the feed in the previous arrangement, and the quick return is obtained by substituting a pair of helical wheels (ratio 2 to 3) with left-hand spiral in place of the right-hand worm and worm wheel, between the feed shaft 2 and the screw.

The epicyclic train consists of the wheels *A*, *B* and *C*, the last-named being the planetary pinion, and is carried on a stud in the cone pulley.

The wheel *B* has a long boss on each side, that to the right being formed as a cone to allow of its being clutched to the cone pulley by means of the hand wheel 8, which has a screwed boss to fit the screwed end of the long boss of wheel *B*. The wheel *A* rides loosely on the boss at the left-hand side of wheel *B* and is held in position by the hoop 9.

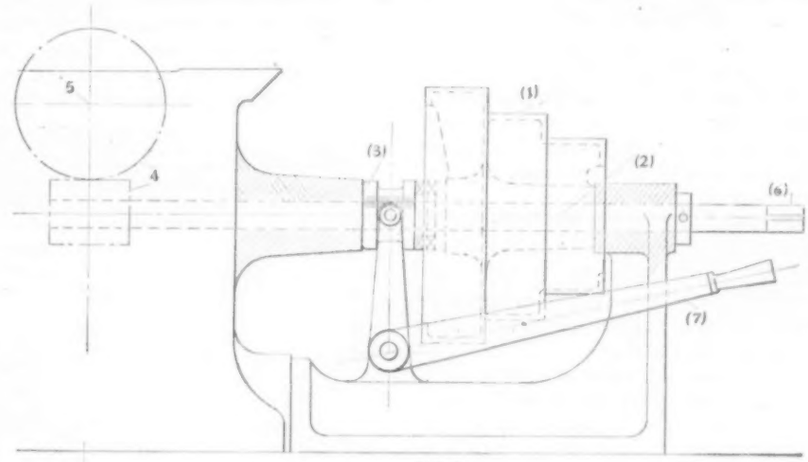


FIG. 1

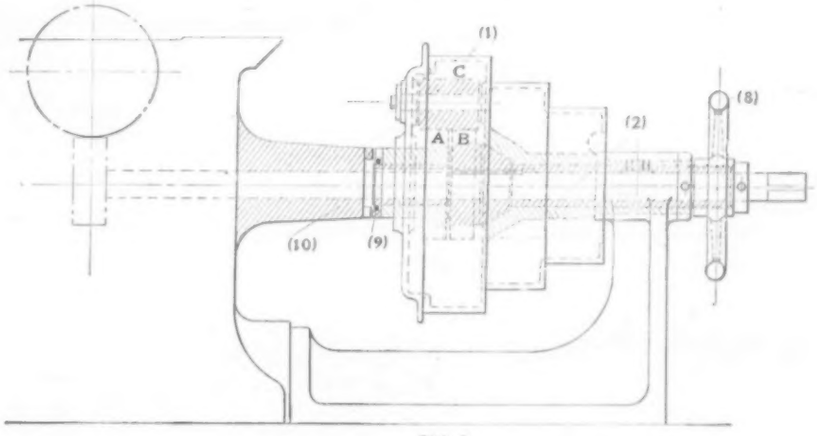


FIG. 2

APPLYING A QUICK RETURN TO OLD MILLING MACHINE

In order to bring the planetary motion into effect, the wheel *A* is fixed by clutching it to the fixed boss 10 of the bed, by means of the hand-wheel 8.

When the epicyclic train is in use, the revolutions of wheel *B* per revolution of the pulley will be

$$1 - \frac{A \times C}{C \times B}$$

in the same direction as the pulley.

$A = 31$ teeth; $B = 30$ teeth; $C = 14$ teeth. Therefore the revolutions of wheel *B* per revolution of pulley will be

$$1 - \frac{31 \times 14}{14 \times 30}$$

in the same direction as the pulley; that is,

$= 1 - \frac{31}{30}$ in same direction as pulley,
$= -\frac{1}{30}$ in same direction as pulley,
$= +\frac{1}{30}$ in opposite direction to pulley.

It will be seen that, in order to obtain a high reduction, we have a 31-tooth wheel and a 30-tooth wheel both gearing into a 14-tooth pinion. This presents, however, no difficulty, as if the 30-tooth wheel be cut slightly larger in diameter and the 31-tooth wheel smaller in diameter, so as to bring their diameters the same, the slight inaccuracy in their form of tooth will not materially affect the smoothness of working.

The rate of feed in the case of Fig. 1 works out as follows:

Cone pulley, 180 revolutions; worm wheel 45 teeth; screw, ½-inch pitch. Feed per minute $= 180 \times \frac{1}{45} \times \frac{1}{2} = 2$ inches.

In the case of Fig. 2, keeping the revolutions of the pulley the same as before, we have:

Feed per minute $= 180 \times \frac{1}{30} \times \frac{31}{31} \times \frac{1}{2} = 2$ inches.

Quick traverse per minute $= 180 \times \frac{2}{3} \times \frac{1}{2} = 60$ inches $= 5$ feet.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Some Bench-lathe Schemes

Fig. 1 is a special counterbore used for cutting a porcelain material and calling for more sharpening than strength. So after drilling for the lead pin *a*, I cut out a quarter of the stock, as shown at *b*, making it easy to grind the tool.

The pin or tit *a* is shown cut away at *c*; when in position it is straight, but before entering the shell it is bent at *c* and spring tempered. This holds it in place effectively, and the scheme would possibly work well on larger tools.

The chuck, Fig. 2, is one in which a great many pieces like *d* are faced off to gage the same distance to *e*. The gage screw *f* is fixed in the plug *g* by the check nut *h*, the former being driven tight into the end of the chuck *i*.

Fig. 3 shows a method of taking a cut on small work which has to be to exact length. The work is driven on to the arbor *k* (and off also) in a convenient block close at hand; the arbor being flattened for the thumb-screw *l*, it is very quickly put in place. The position of *j* on the arbor is of no account, as the work gages itself at *m* either with or without a collar.

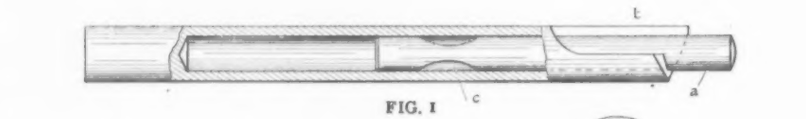


FIG. 1

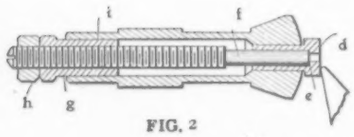


FIG. 2

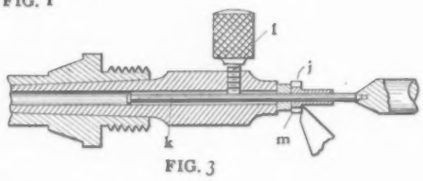


FIG. 3

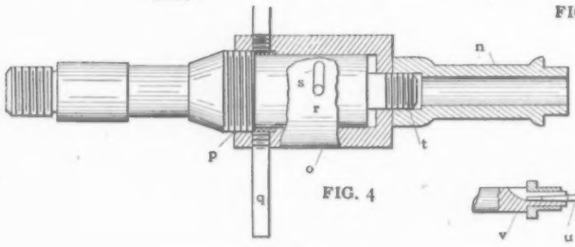


FIG. 4

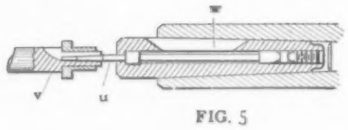


FIG. 5

BENCH-LATHE TOOLS

Fig. 4 is a method of holding pieces like *n* which have to be faced off to length; the work is finished and nurled and must not be marred or bruised when removed. The shell *o* has a left-hand thread at *p* and is provided with handle *q* and a pin *r*. The latter moves in the slot *s*. The work screws on to a right-hand thread at *t* on the solid chuck.

The shell is in the position shown when the work is in place; the two threads working against each other make it tight. When the shell is turned to bring the pin *r* to the other end of the slot *s*, the work *n* can be readily removed with the fingers. The pin projects from the shell far enough to allow it to be removed if necessary.

An expansion chuck is shown in Fig. 5. The expanding pin *u* runs in a taper holder in the tailstock spindle. It is pressed into the split chuck *v* which runs in the lathe head, *u* and *v* both revolving together; *w* is a fine saw slit facilitating the oiling of *u*.

Fig. 6 shows a Sloan & Chace bench-lathe screw-spindle tailstock converted into a push-spindle type by removing the

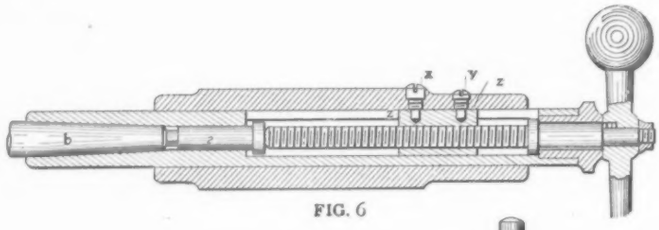


FIG. 6

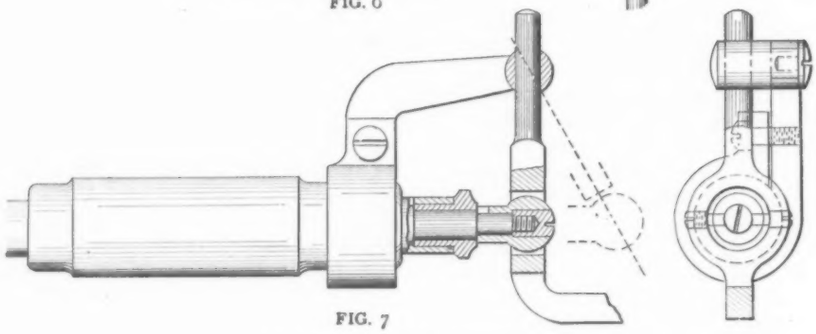


FIG. 7

BENCH-LATHE TAIL SPINDLES

two screws *x* and *y* from the nut *z*. It will be noticed that the center is thrown out in this tailstock by the push plug *a* which strikes the nut *z* and gives the thrust to the center *b* instead of the latter coming against the end of the screw, which travels here with the spindle.

Fig. 7 is a design for a homemade lever tailstock which explains itself.

Brooklyn, N. Y. F. J. LeCard.

Tracing Drawings

Reading an article on page 809 in the American Machinist, entitled "Making Details," by L. J. Monahan, I should like to ask him a couple of questions.

Do I understand that the tracing cloth on which the details are to be inked is to be placed over the assembly drawing of a machine and then one view of a certain detail to be traced off as it is and the other view—should there happen to be front and side elevations—drawn on in pencil, and then inked?

If this is what is meant, does it not become necessary to shift, line up and stretch the cloth each time a detail is traced, or to manœuver the assembly

drawing to the desired position underneath? I tried and abandoned this scheme several years ago, having found that it was not a time saver, but on the contrary that it was a loss both to myself and my employers.

The details of the machine in question, which I had designed, were required in a hurry. So I started in on this scheme to detail it. I might state right here that the assembly drawing which was to be detailed was the same as nine-tenths of the experimental assembly drawings of today, in that there were a great many things left off and a great many changes to be made on the details. Very few assembly drawings—outside of those which are to be filed—are made fit to trace details from.

I do not see how the mistakes are eliminated when there are a great many changes to be made that are to be taken care of in the details. I have found that there is a greater amount of work involved in this method than in the following one, which I use.

In nearly all drafting rooms they have standard sizes of sheets for tool drawings and for the drawings of machines which they manufacture. Having designed a machine or tool, I select the size of drawing paper that I think will accommodate all the details, providing they are all gotten on one sheet. Then I make all the details and dimension them, not putting in any elaborate workmanship and omitting the names of parts and the title. Covering this with the tracing cloth, I trace them all, just inking on the dimension lines and leaving off the dimensions. When I have finished putting the dimension lines on the last detail, I start to ink the figures in on the first detail, at the same time checking it with the assembly and concentrating my whole attention on the completion of this detail, and so on. This I have found to be 50 per cent. better than any other method that I have yet seen, and the work is checked, leaving little for the checker to find.

Jersey City, N. J. WM. J. CHIPMAN.

It Pays to Send Catalogs

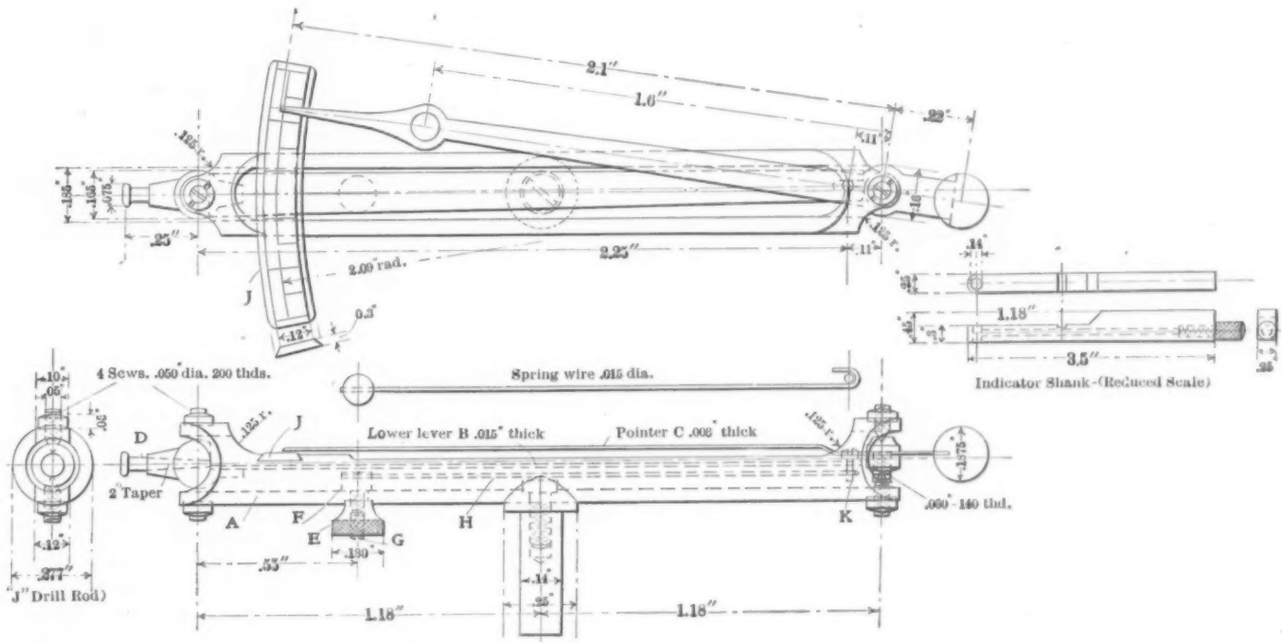
I have noticed of late that it is hard to obtain catalogs of machines. A short time ago they could be had for the asking; but now the opposite is the case, as I have sent postage in several cases and had no reply. I am a foreman and perhaps the firms written to think that it would only be sending wasters, so restrained. It is now considered part of a foreman's job to be well up in the machines he has to control, as well as every other make, so that he may be consulted as regards replacements or new machines; but how can he unless he can have the information at hand? During the last 12 months I have had the pleasure of advising our firm as to the adaptability of several machines, valued at at least £500, through having obtained a large catalog from a large machine-tool agent.

I know of a mill furnisher who wanted a chuck for one of his customers and did not know where to obtain it. His nephew was a chum of mine and he was immediately given the name of the Cushman chuck. This was fitted with a hack by the agent and sold to the mill; they were delighted and gave a repeat order. Every young apprentice in our factory knows Brown & Sharpe, calls it B. & S., and each has a catalog, which is sent freely. They will not always be with us, for some of them are smart enough to take up good positions in other factories; but they will not forget the name of the firm which so readily supplied them with catalogs. They will all be agents without much pay (a catalog now and then) but good ones for all that. So when a catalog is sent away to someone who is not a purchasing agent, don't think that it is thrown away, because the chances are that it has gone to someone who will look it through careully. E. A. RIELL.

Manchester, England.

A Test Indicator

This test indicator, which is practically similar to the one shown in connection with the article on master plates at page 927, Vol. 30, Part 1, was designed principally for truing up buttons and small holes in face-plate work and for general use on the bench lathe. It may, however, be conveniently used for almost any kind of machine or bench work for which any indicator can be used.



TEST INDICATOR (SHOWN ABOUT 1½ TIMES ACTUAL SIZE)

The body or frame *A* is made from bright drill rod 0.277 inch diameter (*J* size). The lower lever *B* is not balanced. The pointer *C* is balanced with a 3/16-inch commercial-steel ball annealed and sawed for the insertion of the pointer.

The shanks of the contact buttons *D* are made taper to facilitate changing for different styles of buttons, that shown being convenient for round work, but one about 0.3 or 0.5 inch diameter is sometimes desirable.

The nurled nut *E* is locked firmly to piece *F* (to which is attached the spring

wire *H*) by means of check screw *G*, the whole being a friction fit in *A*, and is used for obtaining the spring pressure necessary to hold the pointer at either extremity of the scale *J* according to which side of contact button *D* we wish to use against the piece being tested.

The scale *J* is a friction fit in *A*. The dimensions given on the drawing give the pointer a movement 171 times that of the contact point, but this can be easily modified by altering the distance of pin *K* from the pivots on which the pointer moves. The dimension from the pivot to the ball (0.22 inch) is approximate only, the correct distance for balancing the pointer being found by trial.

The construction of the spring center shown to the left of the indicator in Fig. 5 of the master plate article referred to hardly needs any description. It is used in connection with the indicator for truing up work to center punch holes, on the lathe face plate, it being possible to accurately position such center marks in about one-fourth the time required to set them even approximately with some of the old style center indicators.

The only other attachment I have thought worth making is that shown in Fig. 11 of the master-plate article. This I think might be improved on by offsetting to the left the part protruding from the chuck, so that the center line of the indicator could coincide with the center line of the machine spindle. It would then be more convenient for truing small holes in which no plug is used.

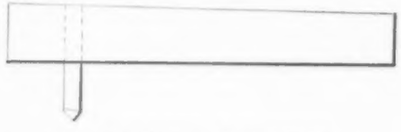
For attaching to a surface gage I use a retort-stand clamp.

The drawings from which both this engraving and my indicator were made were given me by S. Gahan, of Newark, N. J., who, however, does not claim to be the originator of this style of indicator, but says its present design is the result of suggestions received from many able mechanics, particularly W. H. Nichols, of Waltham, Mass.

Newark, N. J. E. M. KING.

Another Improvised Counterbore

The counterbore used by Mr. Hammond is discountenanced in all up-to-date shops



AN IMPROVISED COUNTERBORE

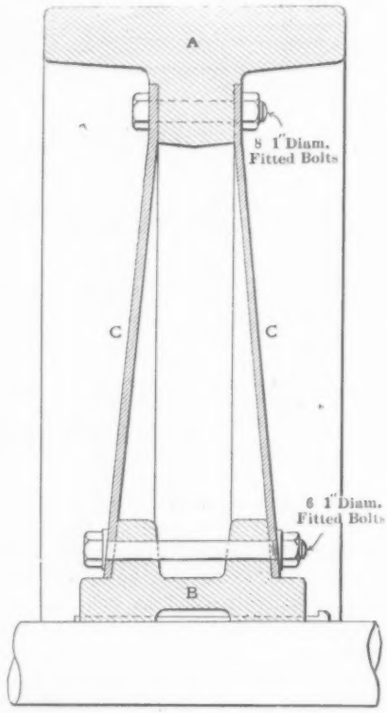
for the simple reason that too many good drills soon find themselves in the scrap pile on that account. In a shop where such a method is allowed the tendency is for the workman to grind the point of the drill flat and then regrind it.

The best and cheapest improvised counterbore that I have ever seen is made by taking a piece of steel the size of the lead hole, drilling an ⅛- or 3/16-inch hole far enough back from the edge to give the lead plug enough guidance. Take a small piece of drill rod, a driving fit in the small hole. Cut to the length of the radius of the counterbore needed and the thickness of the guidance plug. File the drill rod V-shape the length of the radius of the counterbore. Harden, temper and drive in the small hole, taking care to hold it so as to give proper clearance to the cutting edge. These counterbore or fly cutters can be used repeatedly and easily sharpened. Where it is a one-job affair, they are preferable in dimensions to any other I know of.

Newark, N. J. ARTHUR B. TAYLOR.

A Fly-wheel with Steel Plate Webs

The accompanying illustration shows a partial section of one of a pair of fly-



A FLY-WHEEL WITH STEEL PLATE WEBS

wheels recently constructed for a gas engine used to drive dynamos for lighting. The original fly-wheels were too light, so that the voltage fluctuated, and it was decided to replace them by others of a heavier construction.

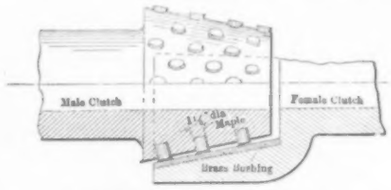
Referring to the illustration, the rim *A* is of cast iron finished all over and recessed on each side for the steel plate webs *C C*. These webs are plates of mild steel ⅜ inch thick, and of a quality such as is used in boilers. They were formed to the required shape on a block in a large spinning lathe, turned accurately to size on the outside and carefully bored at the center to fit the hub. The hub was of cast iron and of the section shown. The method of bolting together the rim, webs and hub is also shown. The wheels when finished weighed about 1½ tons each, and when running have a circumferential rim velocity of 70 feet per second.

J. TREVOR ATHEY.

Glasgow, Scotland.

Repairing a Cone Clutch

In overhauling and repairing a crane recently, we came in contact with a pair of crane clutches made with cone faces,



REPAIRING A CONE CLUTCH

the small end being the driver; it was brass bushed, with general details as follows: Largest diameter, 8½ inches; smallest diameter, 6½ inches; face, 6 inches. The capacity of the crane was about 15 tons. It is safe to assume that at least 20 horse-power was transmitted by the clutch.

In repairing these clutches we found that the brass bushings were badly cut. Upon inquiry we found that they did a great amount of slipping; in order to make them hold, the operator had at times thrown sand into the clutch. This was only done, however, after all efforts to make the clutch take a hold had failed.

So we at last hit upon a plan to use maple friction blocks in place of the metal contact. This is how it was done: Taking a strip of tin, we made a development of the surface of the cone. We then divided its surface into 20 parts or rows of holes, and taking the diameter of our blocks to be 1⅛ inches we spaced the centers so as to distribute the wearing surface.

Placing the templet around the cones, we located the center of each block, and drilled the holes to a depth of 1¼ inches keeping at right angles to the face. After drilling all holes, we drove maple plugs, with a slight application of glue, into the holes. Placing the cone in the lathe after allowing the glue to set, we turned off plugs, leaving about 3/32 inch projection, which gave us a perfect friction surface with the end grain of the wood to work upon.

These two clutches have been subject to use daily now for over six months under very severe conditions, outdoors; the amount of wear appears to be slight. The total cost was only about one-half of what it usually cost to repair the clutches,

and the advantage of the renewal at even less cost, owing to the fact that all holes are now ready for new friction blocks when required.

Another advantage not to be overlooked was the fact that quite a little of the old trouble was due to oil getting into the clutches; at present the oil gets between the blocks, as can be readily seen. In view of the fact that there are very few data obtainable on cone friction clutches, the above solution of our difficulty may interest your readers.

Philadelphia, Penn. S. P. YEO.

Centering Brass Cock Keys

In centering brass cock keys there are a good many reasons why it is not advisable to use the regular combined drill and countersink so commonly used for other work.

One reason is the cost, and another is the constant breaking off of the "tits" on the end. This is principally caused by spots of iron in the brass. These spots of iron are the almost inevitable result of using scrap brass and are the cause of more ruined tools in the brass manufactories than anything else.

In our shop, where thousands of brass cocks of all sizes are turned out every day, a cheap, quick way of centering the rough cock keys preparatory to turning is imperative.

The drills used by us are practically nothing but countersinks, having no "tit" on them. The lathe centers must be kept sharp, which is a very easy thing to do as these lathe centers are made up by the dozen and sharp ones can always be obtained from the tool room.

The stock used in making our center drills is a special grade of quarter-inch round, air-hardening steel. This steel is cut into two-inch lengths and a three-sided point ground on one end, as shown at *M*, Fig. 2. One of the rough centered cock keys is shown at *N*.

Fig. 1 shows a machine for using these drills, which needs little explanation. The drills are put in chucks *C C*, and the cock key is put in chuck *V*; a pull on lever *H* quickly does the job.

Fig. 2 shows an enlarged view of the chuck used and the removable false jaws. These false jaws are made of a size and shape to accommodate the various-sized keys used and are easily removed and replaced by means of the screws *L L*. The chuck itself is exactly like a two-jawed lathe chuck.

The center drills are easily sharpened on the universal grinder by means of the jig shown in Fig. 3, which has been in constant use for three years and is good for as many more. There is a split collet for holding the drill, which is tightened in the usual way. This collet and nut are run through a revolving sleeve which has a nurled wheel *C* on one end for turning it by hand; on the other end the shoulder *M* is divided or indexed with three equidistant notches which, with the use of spring stop *h*, are the means of easily grinding evenly on three sides of the point the drill held in the chuck.

This jig is made so as to clamp on the grinder table at an angle of 15 degrees; the result is that the drill ground in this way will countersink a 60-degree hole.

A regular 6-inch disk wheel is used on the grinder, and this gives the drills just

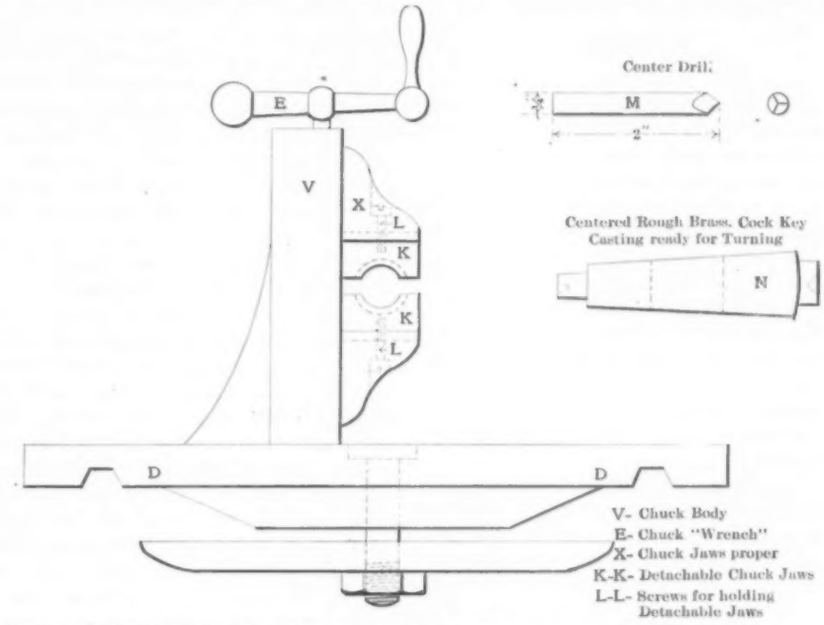


FIG. 2. SIDE VIEW OF CHUCK AND CARRIAGE FOR HOLDING COCK KEYS FOR CENTERING

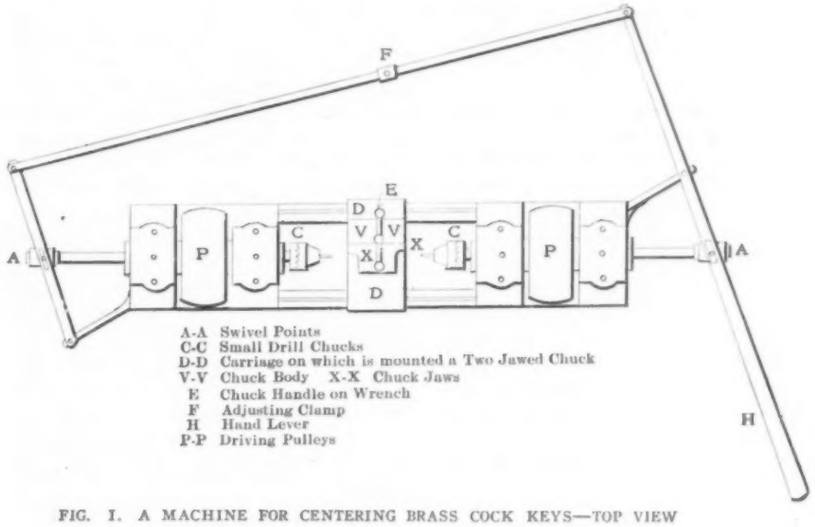


FIG. 1. A MACHINE FOR CENTERING BRASS COCK KEYS—TOP VIEW

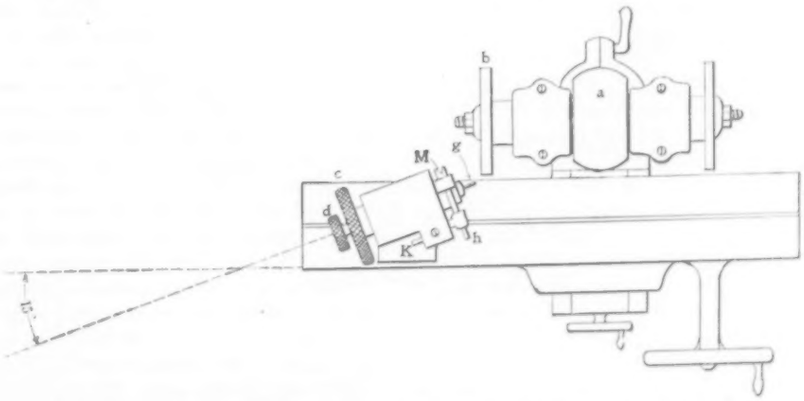


FIG. 3. GRINDING JIG FOR DRILLS USED IN COCK KEY CENTERING MACHINE

enough hollow on the ground sides of the point to cut well in brass.

These drills are cheaply made, easily sharpened, last long and do the work.

Decatur, Ill. ETHAN VIALL.

Proper Shop Training for Engineers

At page 442, Vol. 30, Part 2, Mr. Cardullo pays me the compliment of being wrong, dead wrong, nine times out of ten. If I were not wrong in the opinion of nine men out of ten (when I am writing), I would stop right now. I do not want to inflict my stuff on people who think I am right. It is men like Mr. Cardullo that I am after. If I can make such men think, I am more than pleased, for the result will be either that they will come to think as I do, in which case they may be excused from further reading of my stuff, or they will convince me, which will save other people reading it.

"One thorn of experience is worth a whole wilderness of warning." James Russell Lowell is responsible for this statement, and every man who has felt the prick of the thorn knows its truth. Every boy knows it who has hurt himself through carelessness. Who ever saw a boy cured of climbing out too far on the limb of a tree by scolding or warning? Let him tumble, and in a fraction of a second he has learned more than he could be told in a week. And he will remember it, too. Every employer is calling for experienced men. He takes technical graduates, not because he wants them as they are when they graduate, but because he knows that in order to have them after they have acquired experience he must help them get their experience. If he does not, someone else will.

Now what constitutes this experience that men pay so much for? Simply this, an experienced man is one who has had to suffer enough through infraction of the laws of nature so that he respects those laws, and so that he observes them himself. Why are not technical graduates, that is, green graduates, experienced? The question of age does not enter here, the 12-year-old newsboy on the street is more experienced than the graduate. The question of environment does enter. A boy goes to school at 5 or 6 years of age and stays there till he is 22 or more. All that time he is coddled like a sore thumb. No big stick for him nowadays. No tasks that have to be done, rain or shine, willing or not. Everything planned out to make life pleasant and easy. When school does not keep, he can sit on a fence or play ball or row or do any of the things that please him. When he is in school, he is led along an easy way amid the difficulties that other men have had to conquer; his bills are all paid by an easy-going father. He doesn't know the value of time or money. Nor does he know the use or value of what he has learned.

THE TWO EXCEPTIONS

There are two exceptions: one, the boy who is so fortunate as to have to earn his way; the other, the boy who goes in for athletics. Do these boys go about their training the way they are trained by the college faculty? No, sir! They know better. When they get hold of a freshman that needs to be taught his place, do they make it easy for him? Do they pick out the soft spot in the field to teach a new man on the team how to fall on the ball? Not a bit of it, and they get all the conceit out and knowledge in, in less time than any professor ever did the same amount of work in his class room.

I have still a quantity of medals, ribbons and cups won on the athletic field, and I have a sheepskin. I don't know where the sheepskin is just now, but I do know where the medals are, and they are worth more and were worth more in the getting. Now I believe that if Mr. Cardullo will look back, he will find that the knowledge that has done him the most good was hard earned. He may say that it ought to have been given him in school; but it is outside of human possibility that all the information that a man may need should be given him in four years, even if the engineering world were not progressing so fast that it takes a pretty good man to keep up, to say nothing of catching up.

I agree with Mr. Cardullo in his second object of shop training for engineers, "To teach the student the methods of manufacturing and the ways in which the best methods may be developed," but if I were especially interested in a boy who was going to attend Syracuse University, my advice to him would be to disobey orders and try to do his work by some other method than he was told. He might make a failure of it, but it is worth more to know what cannot be done than what can be done. He might graduate at the foot of the class, but he would be worth more to me then than the student who did as he was told.

ONLY ONE PRINCIPLE EMPLOYED

There is really not such a great deal that an engineer needs to know about machine work or pattern work, after all. It can all be simmered down to a few principles. Did you ever stop to think that all they do in a machine shop is to hold a cutting tool up to a piece of work and then move one or the other? Of course there is a variety of ways of doing it, but the principle is the same all the time. If a student learns by experience what shape of cutting edge is the most durable and the finest cutting for one form of tool, he is in a position to use judgment as to the best shape to use under other conditions.

It is true that it is not easy to make a patternmaker in three weeks, a foundryman in a week and a half, a blacksmith in a week, etc.; in fact, it is impossible by any method, natural or artificial. I do not wish to see an engineering school turn out machinists or patternmakers. I do wish to see them turn out graduates thoroughly grounded in the basic principles of all these trades, but that they should be good craftsmen is farthest from my idea.

Mr. Cardullo says that in order to utilize the natural method to advantage it is necessary for the student to repeat each exercise several times. I do not think so. Many times the first piece would be enough. Suppose that the instructor finds a boy starting wrong. Instead of telling him just what to do, let the instructor ask him a question as to the result of what he is doing. It will open the boy's eyes just as well as if he carried it through to a failure, provided he sees the point. But always make the boy start alone. If a student or a man does a thing the wrong way and it is accepted, he will undoubtedly do it the same way again; but I do not plan that a wrong method should be allowed to go past without being corrected. However, there is more than one way to skin a cat, and I should hate to tell a student that I knew the absolutely best way to do even the simplest thing. There would almost surely be some student who already knew a better way.

But as Mr. Cardullo went on, I saw that he was getting ready to follow my line of treatment, for I saw that he proposed, after a student had gained experience, to have him write out his own instruction paper. Where we would differ is that Mr. Cardullo would probably amend the paper himself, which would not impress the student, while I would simply ask the student questions that would set him to thinking. That is my most essential point: to set a student to thinking.

Now I want to ask Mr. Cardullo one of these questions: What is there in his course as planned that will teach the student how to do good work with the most uncompromising tools and apparatus?

Boston, Mass. ENTROPY.

Using Beveled Side of Emery Wheel

As I have had some experience in grinding formed cutters as well as other kinds, I feel that I cannot agree fully with Mr. Ramopon. I know he can grind his cutter in about half the time it takes to grind it on the flat side of the wheel, and I would like to say right here that I have met many men who do not seem to realize that an emery wheel will cut much faster and with less heat (other things being equal) on the round or beveled side than on the flat side.

But I must ask Mr. Ramopon how he would find it possible to grind a formed cutter of say 1- or 1½-inch thickness where the teeth may be 2 inches diameter at one end and 3½ inches diameter at the other end and have it radial? Grinding the teeth of the cutter on the beveled side of the wheel will leave them concave on the face.

My practice is to rough grind the teeth on the beveled side of the wheel, as Mr. Ramopon describes, to take out the stock quickly and without drawing the temper of the teeth, where the latter are not too long or where the shape is such that it can be done without spoiling the teeth, and then to turn the cutter over and straighten up and finish the face of the teeth on the flat side of the emery wheel. In this way the cutter is quickly and correctly ground, and without drawing the temper of the teeth.

Bridgeport, Conn. E. S. WILLIAMS.

I noticed on page 910 some remarks on using the bevel side of the wheel for grinding formed cutters. I have been using various kinds for several years: emery, carborundum, corundum and alundum, of various degrees of coarseness and hardness and have tried both the bevel and straight sides. I find in grinding with the bevel side that it is necessary to regulate the pressure to retain the original form at the cutting edge, for if the cutter is of very irregular form it will run the cutting edge back farthest at the smallest diameter of the cutter; this leaves the piece milled too high at that point.

To remedy this possible mistake and when extreme accuracy is required, I use both sides of the wheel, using the bevel side to remove most of the stock if the cutter is quite dull, and the straight side to finish, as it grinds the front of the teeth more evenly. GEO. E. QUINN.

Hartford, Conn.

I must disagree with the use of the beveled side of grinding wheels, as suggested on page 910.

A grinding wheel will cut just as freely on the flat side as it will on the beveled side if it is kept clean and not allowed to gum up by grinding on it soft materials such as brass or lead. Even grinding a lead pencil on the side of a wheel will gum it up. As the flat side of a wheel cannot be trued off many times, care should be taken in the selection of the proper wheel.

Grinding on the beveled side of the wheel does not produce a flat surface but a curved one, and thus the cutter will not produce the correct shape. This error becomes more pronounced as the wheel grows smaller and the curve becomes of a less radius. In the case of an irregular-shaped cutter this error would be sufficient to produce bad work. Also if the center line of the thickness of the cutter were not in line with the center line of the wheel, one edge of the cutting face would be in advance of the other. A cutter ground in that manner would not produce the correct outline. This adjustment of the center line of the cutter and wheel would have to be quite close. This has the disadvantage that if six or more cutters of different thicknesses were to be ground, a separate adjustment for each cutter for hight would have to be made.

I have ground cutters and formed tools by hand of all shapes up to 1¼ inches thick, supporting them on a rest on the flat side of the wheel and never had any trouble with drawing the temper. I used a soft, coarse wheel to rough out with and a fine, soft wheel to finish with. The wheel for roughing was a 40K and the finishing wheel was 60M.

With the proper wheels I can get quicker, more accurate and better results from using the flat side of the wheel than Mr. Ramopon can by using the beveled side.

A good rule to post up at the cutter grinder is: This grinder for grinding cutters and nothing else.

Lowell, Mass. PAUL W. ABBOTT.

Calculations Respecting Epicyclic Wheel Trains

Judging from the number of communications on this subject, it appears that the solutions of epicyclic gear trains given from time to time in the columns of the AMERICAN MACHINIST have evoked considerable interest, partly no doubt, from the fact that there is an increasing tendency for this comparatively little known class of gear to come into practical use.

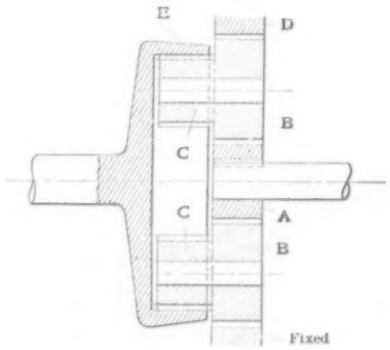


FIG. 1. BAKER COMPOUND PLANETARY GEAR

An interesting gear, a solution for which I have not as yet seen printed, is the Baker compound planetary gear. This is shown in Fig. 1, in which A is the driving or sun pinion, B B the first-motion planets, C C the second-motion planets, and D and E the fixed and free annular gears respectively. The slow-speed shaft is coupled direct to E. The first reduction is a simple sun and planet one; for one revolution of the planet cage the sun A will have to make $\frac{A+D}{A}$ revolutions. Reasoning out the second stage, it will be obvious that if C were made squal to B, then D and E must be alike, and that although E were free to revolve it would not do so. Consequently the nearer C and D approach each other in size, the greater will be the speed reduction between the driving and driven shafts. This feature has been fully taken advantage of, and I believe the makers market this gear with reductions of over 400 to 1.

Suppose that all of the gears including the fixed gear D were solidly locked together and revolved bodily round the shafts; then relative motion would be prevented and for one revolution of the planet cage the free annular wheel E would revolve once. In other words, all its teeth would pass a given fixed point once; but D being fixed, the planets B and C must revolve in a contrary direction to that of the shafts and the planet cage. The number of teeth actually moved back can be obtained by dividing the fixed annular gear D by B (giving the number of revolutions of the planets on their axes for one revolution of the cage) and multiplying by C. Thus for one revolution of the planet cage, E advances $E - \frac{D \times C}{B}$ teeth. Dividing this quantity into E gives the number of revolutions of the planet cage for one revolution of the driven shaft. The complete formula for speed ratio becomes:

$$\frac{A+D}{A} \times \frac{E}{E - \frac{D \times C}{B}}$$

$$= \frac{A+D}{A} \times \frac{B\,E}{B\,E - C\,D}.$$

As an example, let $A = 24$, $B = 36$, $C = 24$, $D = 96$, and $E = 84$ teeth. Then the reduction will be:

$$\frac{24+96}{24} \times \frac{36 \times 84}{36 \times 84 - 24 \times 96} = 21 \text{ to } 1.$$

ARTHUR W. JONES.

Glasgow, Scotland.

Scraping—Bolting Planers to Floor

Your article in regard to the necessity of scraped bearings should bring many replies. As I have had a long experience on planer work, I will say that I think the V's on a planer bed and table or lathe bed, or any other piece like the planer rail or column of a milling machine, should have the loose iron scraped off by hand, for if this is not scraped off it must wear off. The loose iron can readily be detected by rubbing a linty rag or piece of waste over a newly planed surface. If the finishing cut was the best possible, the lint will

not stick very much if rubbed in one direction; but it will if rubbed the other way. Now when a surface has been properly scraped you can rub a rag over it without leaving any lint sticking to it; that's the difference.

You speak in your article about the piece of steel looking like a piece of finely grained wood and showing various degrees of hardness at different points. It is very evident that the texture of steel is more even than cast iron; if places could be seen in the steel showing hard spots or veins, those places should be scraped.

Cast iron often will show places where the metal has run closer, and these places or spots offer more resistance and spring the tool away. To make the slides and parts of a machine sensitive and ready for nice, quick, clean work, I think scraping is necessary. In this city is a firm building planers (and there is none built better); they scrape the loose iron off the bed, table and any other sliding parts where it will help to make the machine look and work smooth.

If a large piece is not planed true, you had better have it replaned at once, for it is next to impossible to scrape a large surface to any great extent without leaving holes or deep spaces in the bearing.

Bolting Down Planers

I will say to C. H. Norton that I have had to level a number of planers. On several occasions I would have been able, through the use of foundation bolts, to pull the planer beds down level, as they had not been planed straight by the makers. Two of these planers we replaned; the others were used on work where the small error in the planer did not show much. As far as keeping a planer from sliding off its foundation is concerned, some of the old style required something to hold them. I think it advisable to arrange planers that are not very large and heavy, which are intended to run at high speeds, with stops at the front and back ends of the bed, as they are liable to slide from the quick jars at reversing.

Cincinnati, O. H. L. Cameron.

Why Are Planers Bolted Down?

At page 957, C. H. Norton asks why planers, etc., are frequently bolted to the floor, that is, to their foundations. I think that the answer is merely "habit." I remember how an old Fitchburg planer with a bed 45 feet long and about 3 wide used to slide all over its foundations, particularly at the ends where the least weight was. The length and thinness of the bed casting made it elastic enough to do quite a jig between one of the table's reciprocations. The only way to remedy this was to fasten it down at all the feet. No one will blame the foreman who went through that experience for immediately bolting any and all planers which come under his care. Of course this would not be the wisest policy; but many people who get the name of being fairly smart acquire it by living out the old adage about an ounce of prevention being better than a pound of cure.

I remember one case where a lathe was not bolted to the floor. A young machinist friend of mine was turning short, heavy shafts on a 28- or 30-inch lathe in the Brown-Hoist plant in Cleveland three or four years ago, when they were renovating their shop. He was on the night shift and had just finished a shaft about 4 feet long and 6 inches in diameter. He fastened a chain around it and signaled the crane man. For some reason, either darkness or mistake, the crane man hoisted away as soon as the hook was attached, that is, before the tail center was withdrawn. The consequence was that the lathe swung into the air and started to revolve, my friend just dodging a foot as it came around. Luckily nothing harder than air was in the path of the lathe or there would have been a smash.

In case of a similar occurrence to a job on a planer, of course only the table would be likely to fly, whether the rest was bolted to the floor or not. The only thing that can be said in answer to the whole question is that judgment must be used, and light machines which can be pulled over by a caught belt should be bolted down.

Toronto, Canada. W. L. McL.

Does It Pay To Write?

I think every man who has attempted to prepare a paper for some public occasion, or who has struggled with the problem of writing a book, or who has written articles for publication, has asked himself this question: "Does it pay?" I do not know as I am competent to answer, but as I have asked myself this question so many times I will give some of the answers that I have given to it.

Does it pay to write? Well, it depends on how one writes. If he is wedded to a pet theory, would not be convinced that anyone had a right to any other view of the subject, is inclined to belittle everyone who holds a different view, and has a sarcastic way of saying things about people who differ from him, then I should say that it would not pay such a man to write. Many men are sensitive and cannot stand ridicule; I have met quite a number of bright fellows who are "well up" in certain subjects and I have asked them, "Why don't you put what you know about this subject in writing and give some of the rest of us the benefit of your knowledge?" The answer usually is, "Oh! there are men who know more than I. They would write an article picking mine to pieces, and I should feel so small and cheap that I should never want to look my shopmates in the face again."

Now, as a matter of fact, we see very little of that spirit in the up-to-date mechanical journal. I don't know whether men who write are getting more considerate of the feelings of their fellow workers, or whether the blue pencil in the editorial room is more busy than it used to be.* However, no one need fear abuse through the columns of such journals as we are considering, if he takes pains to present to others the knowledge he has been getting from practical experience, or study, or both. If any honest man is wrong and is open to conviction, he will gladly welcome any ideas from others that will set him right. However, man is a peculiar creature and does not care to have the other fellow use a club as a means of disseminating knowledge. Some of us are apt to think the club a particularly useful weapon in our own hands, but a decidedly objectionable article in the hands of our opponent. Now many would-be writers who are capable of great things are deterred from writing on account of the imaginary club, which in reality does not exist, or if it does, the wielder of it will be powerless when he comes up against the blue pencil of the editor.

Men are not all alike. Some men care very little for criticism or ridicule, but I think the man who is a master of his subject, and who by experience and research has dug down deep is apt to hold jealously to his ideas. He should be open to conviction, and I think as a rule he is. But he is sensitive as to how his views are handled and just how the other fellow tries to cram opposing views down his throat.

If two men working under different circumstances are experimenting along the same line, their conclusions may not be alike. If these two fellows can come together and show each other the reasons for their conclusions, in all probability each will be convinced of some errors. If each grabs a club when he catches sight of the other, there is a strong probability that neither one will be the better for the interview. While a certain class of spectators might be highly delighted with the encounter, I am sure the class of men who read the American Machinist would not enjoy it.

If there is any one way in which a man is able to find out what he does not know regarding any particular subject, that way is to write a satisfactory article on it. I mean one that will be satisfactory to himself. If his experience is parallel to mine, he will find many things that he will be obliged to look up. In this way he will find the work educational to himself, and I am sure it will prove educational to

*The American Machinist never allows a writer to ridicule or throw contempt on the work of another.—Ed.

some of the readers. I have, as a result of study when writing an article, gotten certain knowledge that well repaid me for writing the article. I remember writing at one time about milling-machine cutters. While I had made hundreds of such cutters, had had many thousands made in my tool room, and knew when I saw a cutter whether or not the angles were right for the purpose for which it was to be used, yet when it came to stating definite angles for the instruction of others, I found that I was obliged to look over my stock, select those that were about right and measure the various angles. It is needless to say that I have never forgotten them.

I am sure that most mechanics stand just where I stood before I commenced to write. They know how to make things and are able to give tools proper clearance and other angles. Yet when it comes to telling others just what these angles are they find it a difficult matter. Then again another man's experience may not have been just parallel to ours. By a careful comparison of methods and results both get enlightenment that may be of great help to them if they are ever called on to work under different conditions. Not only will the writer have been helped, but the readers of the paper will get information by this mutual exchange of ideas that they could not have gotten through an experience of their own.

I remember having been asked to present a paper at an educational convention. It was to be on the advisability of the adoption of the metric system of measurement in our work shops. I started the paper, spent many hours upon it and learned a great deal that I didn't know regarding the system and its adaptability to our conditions. I telephoned the secretary of the society that as a result of my preparation I should be able to present a paper favorable to the negative side of the subject. My offer was not accepted. While the members of the society were not benefited by my study, yet I have always felt that I was amply repaid for the time and work I put upon it.

Of course we all look forward to a remuneration for our labor in preparing an article, but of vastly more importance to us is the habit of application and the education which we get. The good book says "none of us liveth to himself." If we possess knowledge, it is our duty to give to others, in order that they may benefit by our experience as we benefit by theirs.

E. R. MARKHAM.

Cambridge, Mass.

The several articles recently published under the caption, "Does It Pay to Write?" are all interesting and have led me back to my best days in creating foundry literature, and to try to balance my account and note some of my experiences.

My first article appeared on January 15, 1881, taking up the whole first page of the AMERICAN MACHINIST. It had taken much effort on the part of John Doolittle and your editor to get me started, and the first article was the only one that I thought I could possibly give to interest the trade, as I could not conceive of doing anything in this line that would cause the best masters of the molder's art to sit up and take notice. It was but a few hours after I had seen my first article in print that solicitations for more came from the editor of the AMERICAN MACHINIST, Mr. Bailey, who has since passed from us. I felt I had given all I could think of in the line of articles and wrote the editor to that effect, but my above-mentioned friend and the editor would not let me rest. Finally I agreed to try again, but became much discouraged as time wore on without having accomplished anything which I considered creditable.

It was an effort, until suddenly the thought came to me, What is the principle involved in the work I am doing? This occurred during an evening of thought, and the next day I could not drive the query from my mind; it seemed to face me in everything I would do, and I became more and more awakened to the great work and the open field that lay before me. I had served six years' apprenticeship under one who was called a "king of molders," doing some of the best and heaviest work in the East, and I had worked on jobs in quite a number of the leading foundries, alone and with some of the best molders going. Still for all this I could not tell why I did certain things, nor could I find anyone else that could do so, though their hair was gray with the time spent in struggling with the luck work of making castings. I was awakened to the grave discovery that we were little else than a lot of imitators. I did what I did because I saw Andrew do it, and Andrew did what he did because he saw Harry do it, and so on down the line.

I soon became miserable in my ignorance of principles; but being encouraged by the field of creative work that I saw lying before me, I started in with such enthusiasm that the AMERICAN MACHINIST was soon publishing lengthy articles from my pen nearly every other week. I fell deadly in love with my work, and it was nothing for me often to be called to breakfast without having risen from my desk during the night. I became so interested in my studies and researches that I soon became accustomed to the need of little sleep and averaged about three and one-half hours per night.

How my articles were received is left for others to say, but the humorous part of the work was in everyone's thinking that I was a gray-haired old man, an honor I have yet to obtain. It was a by-word in the office of the AMERICAN MACHINIST whenever the publisher received one of my articles to say, "Another communication from the old man." When I was asked by John Wiley & Sons to write a book, I felt called upon to disclose my age, for to assume authorship so young I felt was no little responsibility. There are several pages more that could be written to describe earlier experiences that some would no doubt take interest in reading; but to the question, Does it pay to write? I had to say, in certain ways, yes, emphatically yes.

One who writes solely for the money that is in it will be, as a rule, very poorly paid in the field of scientific or mechanical literature. I have written five books, three of which have passed their tenth editions, and besides these, sufficient matter for societies and technical papers to make several more books. In all I have cleared over $6000 on my writings. As near as I can find out, this is very good pay and much better than other mechanical writers have received for their work. But let us figure what it nets one per hour as a wage worker. If I have given up one hour to writing aside from my 10 to 12 hours in daily shop work and management, I have spent since 1881 at least three hours per day if not four, but we will compute with three to see the best gain that was made in writing. Divide 28,470 hours by $6000 and you have a wage rate of about 21 cents per hour. Is there anyone who is qualified to write who could not employ his time to gain more money per hour if that were all that was thought of? If I could have kept all of the $6000, it would not have been so bad; but it is safe to say that nearly a half of this amount has gone in paying traveling expenses to read papers, experimenting or making tests, etc., together with postage stamps and stationery to answer correspondents. It must be remembered that answering questions gratuitously, as an author is expected to do, takes time as well as postage stamps, and this labor for a popular writer is no inconsiderate item.

While on the question of losses, there is another factor that some writers have to figure with—that is the abuse and rebuffs they often receive in return for their gratuitous labors to benefit others. It is often a most thankless task, and many think that they cannot kick a writer too hard in lieu of the million he is supposed to have made by his writings. I feel in my own case that some think I am a millionaire through robbing the "dear reader," and that I had no right to expect anything but rebuffs. What credit and encouragement I have obtained has been greatly through the fighting of a few friends. There is more that is discouraging and not paying that might be cited to forewarn fully the beginner who anticipates being a

writer and desires to know in what way writing truly pays. However, sufficient has been said to cause many to do a little thinking along lines that should open their eyes to errors and abuses that, if corrected, could lead to much good in encouraging men that know and can benefit their vocations by creative literature.

Striking a balance to discover the losses and profit by writing, I believe that men of large experience will agree with me in saying it lies chiefly in broadening oneself and getting out of the rut of being a mere imitator. There is one factor which those who have never written are compelled to learn; that is the fact of its being an easy matter to sit in a shop and "blart" what one thinks he knows or can do, but let him write for such a paper as the AMERICAN MACHINIST, where, instead of a handful of unthinking men, he has a world audience of broadly experienced, intelligent, critical workers, and he will be very apt to think twice before he speaks once—and then ten to one feel like not speaking at all.

I could continue writing on this interesting subject, but in closing will say that with all my experience, if I had to do my writing over again, I would commence with the same enthusiasm, for I know it pays in preventing a man from being a mere imitator and broadens him in a manner greatly to kill his conceit and bring him rapidly to a mastery of his calling in a way impossible by any other means.

THOMAS D. WEST.

Sharpesville, Penn.

Does It Pay to Read?

Of course I mean, does it pay to read the AMERICAN MACHINIST? The happily phrased editorial of a few weeks ago, "Does It Pay to Write?" aroused many interesting comments. Through them all ran the same optimistic note of the many advantages coming to the man who writes. Yet it seems to me that their authors have rendered only a minority report. They are only a few, a very few, among the ranks of the readers; and while the trend of the majority report would probably not differ in sentiment from that which has been expressed, still it should be presented.

The articles inspired by the editorial question "Does it pay to write?" have been without exception encouraging in tone and filled with suggestions to him who might wish to enter the writers' ranks. Cannot these words have an influence strong enough to start some members of the readers' ranks to act as scribes and, stepping out into print, tell us of the attitude of their comrades and discuss, "Does it pay to read?"

My own answer is yes! decidedly yes! Many of the broadening advantages ascribed to writing are attendant upon intelligent reading and the application of the information thus gained. The financial side is evidenced by making use of some suggestion, gathered in reading of another's experiences, in solving some knotty problem of one's own.

Two incidents, recent happenings and occurring on successive days, will illustrate this latter feature. I had been shown through a large engine-building works and on my return to the office was chatting with the general manager. Several special tools had attracted my attention; among them was a hollow drill at work cutting a core from a large shaft. In an effort to show my appreciation of the excellent mechanical ability displayed in originating the appliances which I had seen, I mentioned particularly this hollow drill. The manager replied that he was very largely indebted to the reading columns of the AMERICAN MACHINIST for the details so successfully in use in that special device.

On the following day business took me to the large factory of a firm making gears. The mechanical engineer showed me some heavy steel pinions having a large square hole and worked out of the solid. I remarked on the general cussedness of making square holes square and asked him about his methods. Among the operations was one of drilling, using a three-cornered drill and producing an approximately square hole which could be easily broached to finished dimensions. He volunteered the information that the idea of the triangular drill drilling a square hole came to him from reading the AMERICAN MACHINIST. In both of these cases it paid to read and paid in a very practical fashion.

Simsbury, Conn. A. L. PRATT.

An English Tool-room System

Accompanying this are two photographs, one of a check or tally board and the other of the boxes containing drills. In No. 1 will be seen the board numbers of the drillers. At each intersection of the lines is a hook to hang tallies on. In No. 2 two hooks are shown at each box for the same purpose.

A certain number of tools belong to each box, and a corresponding number of disks representing these tools are hung on the right-hand peg of the box. When a tool is taken from its place, a corresponding disk is also taken and placed on the user's peg; one of the tallies is taken from the user's number and placed on the left-hand peg of the box from which the tool was taken. It is easily seen that:

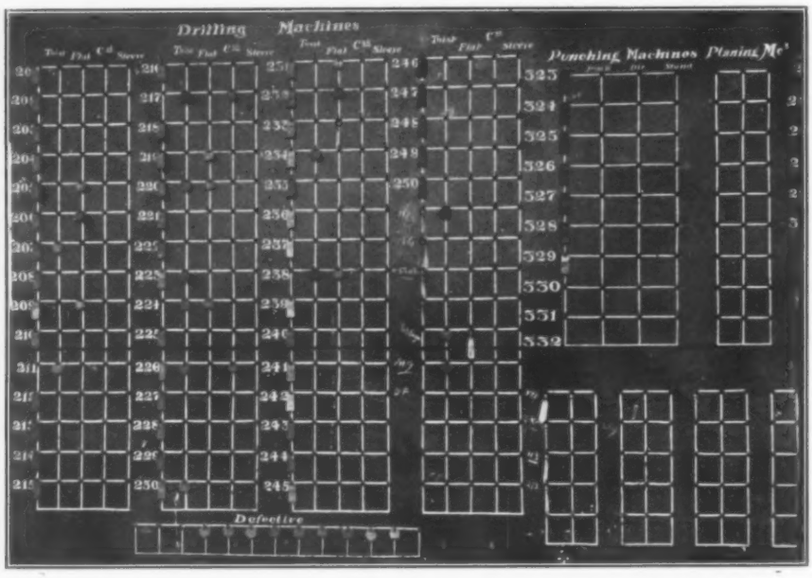


FIG. 1. CHECK OR TALLY BOARDS FOR DRILLING MACHINES

The number of users' tallies on any box ought to correspond to the number of tools missing, unless some tool has been returned defective.

The number of disks on any box, representing the tools, ought to correspond to the number left.

The total number of tallies and disks on any box should be the same as the number of tools allotted to that box, unless some tools have been returned defective.

In the case of a tool being returned defective (blunt or broken), it is put into a box until such time as it can be repaired; the disk representing that tool is taken from the peg opposite the workman's number and put on a peg for defectives. Thus on examining the board I am able to see how many and the different types of tools any man has.

When looking over the stock of tools in the boxes, if the number of tallies on

any box does not equal the number of tools missing, I look among the defectives and find them accounted for there. In this way I am able to keep track of tools in circulation.

When a tool is "scrapped," a similar one is drawn from the reserve stock to replace it: For the various tools, different shapes of disks and tallies are used, namely: a complete circle for a twist drill; a similar disk but with a piece snipped off for a flat drill; a similar disk but snipped on the sides for a countersinking drill; a long tally with the corners snipped off for a punch; a similar tally with a hole through the end for a die suitable for the above punch.

For tools used but seldom or for tools used by men who rarely borrow one from the tool room, the white tally used on keyrings is very suitable. The attendant writes on one side the man's number and on the other the article lent. This tally is hung on the board, and opposite the peg is chalked the man's number, as shown on the photograph. It is advisable to have all tools brought in at certain intervals to make sure they are really in existence, and also to limit the number of tools obtainable by each man. If a man wishes to exceed this limit, he can get a special order from his foreman.

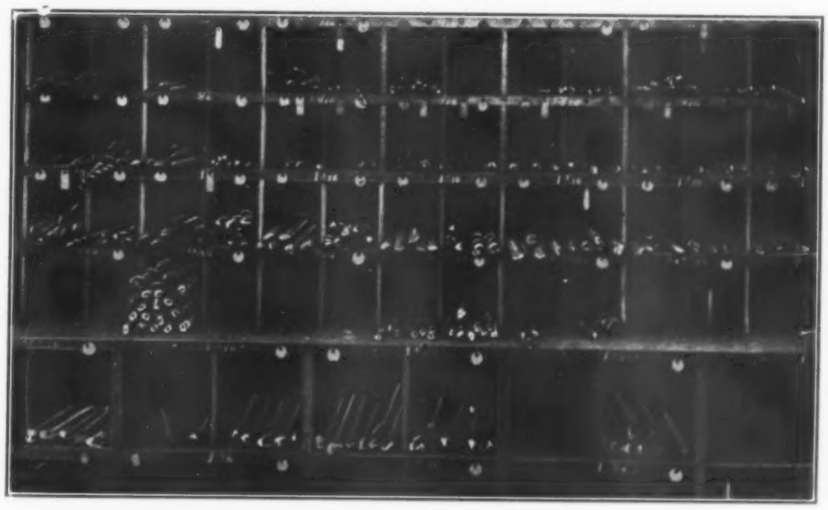


FIG. 2. BOXES FOR DRILLS WITH CHECK-TAGS

ROBSON CHARLTON.

Darlington, England.

The Tool Designer's Trouble

So thorough and complete an indorsement of my kick in behalf of the tool designer as Mr. Winchester's article, page 983, shows, is very gratifying.

The narrow outlook is one of the things objected to; to issue an ultimatum that "you design tools for the machine before you and attend to that alone," seems to me the hight of folly. If the tool man, whose whole aim, be it understood, is to lower the cost of production, is not allowed to criticize, in order that his aim may be attained; if he is to take any piece just as it comes from the detailer (generally an unpractical man) and not exercise upon it his influence and knowledge in favor of cheapening; if he must be limited, not by his own attainments, but by the lack of attainments in others, then I think my kick is well applied.

It is to be admitted that the tool man sometimes asks for changes that will benefit his design. Why not? Surely unnecessary expenditure in any way, be it in tool designers', toolmakers' or tool users' time, is to be avoided.

Is the tool man simply to look at the finished work and not at the cost of the tools to produce it? If the substitution of cold-rolled stock for machined cast iron will save a milling fixture and incidentally the cost of a jig, must the tool man refrain from suggesting for fear of offending the susceptibilities of the machine designer? Is he to confine his thinking entirely to the jig and let the broader issues escape?

It is to be feared that such limited practice has been responsible for much of the misunderstanding which surrounds the tool man's position. The theory that a boss toolmaker's work fits him for the designing of tools is untenable. It fits him for the making of tools. That is all. He may be a good tool designer, and again he may not; yet his skill as a toolmaker can remain unquestioned.

A good toolmaker need not possess the inventive faculty which is so absolutely necessary for a designer. That power to see things in embryo, to view the question from all sides, to rise above the trammeling influence of what has been—these do not come with mechanical skill, the handling of men or other "boss" qualifications.

Furthermore, the tool-room foreman does not stand alone in his knowledge of the equipment of the plant. The accumulation of such knowledge need not fill the aspiring designer with fear. It can be obtained with comparative ease. Also the knowledge of the degree of accuracy to be maintained presents no especial difficulty. It will be found that the greater difficulty lies in having the jigs made within those limits.

Mr. Winchester refers to the shop man's feeling toward the tool designer, as being caused by the latter's tendency to abolish the skilled man. If the users of jigs were good all-around mechanics this argument would hold, but, as a rule, and I speak from painful experience, they are not, emphatically not.

Much admiration can be expressed at the attitude of Sholto McKim, page 953, toward the management, yet one would venture to say that their opinion is of considerable value. At all events an idea to the contrary could be easily dispelled on pay day.

Of course one can more easily afford to ignore the kicks of the users of the jigs, but it must be remembered that all live together and that harmony is a very desirable thing. It is the difficulty that the tool designer experiences in maintaining this harmony that causes the "tired feeling" from which so many of us suffer. A very pertinent fact is that most up-to-date firms want the tool designer, and it is only a question of time before his position will be firmly established in all shops. When such is the case there will be no need to recapitulate the troubles of the tool designer.

Cincinnati, O. A. J. BAKER.

Pouring Castings from the Blast-furnace Melt

It is generally considered as essential that iron smelted from its ores must first be run into pigs and these pigs remelted for casting into foundry products; still this re-melting is not an absolute necessity. A casting made directly from the blast-furnace melt has the advantage of less labor and fuel. There is also an advantage in a smaller amount of sulphur in the finished casting, for the sulphur in the fuel appears almost wholly in the castings, because of the great affinity between the iron and the sulphur. On the other hand, there is less homogeneity in the product of the blast furnace than in the product of the cupola.

A Northamptonshire firm of iron smelters has of late been successful in casting segments of the great lining rings of one of the London tunnels direct from the blast-furnace melt, as well as other smaller articles, such as pipes and columns. In ordinary foundry work the desired quality of melt is attained by varying the proportions of pig and scrap charged into the cupola. In direct casting from the blast furnace the quality is attained by suitable choice of the ores which are fed to the

furnace. The local Northampton ores are a variety of brown hematite and have been used since 1852. The construction work of the London Tube Railway offered a demand for enormous quantites of castings and gave rise to the process which is now being used. A representative analysis of this product is shown by Table I.

	1	2	3	4	Mottled.
Combined carbon	trace	trace	0.131	0.207	1.179
Graphitic carbon	3.790	3.190	3.223	3.229	1.166
Phosphorus	1.662	1.672	1.6	1.584	1.648
Sulphur	0.006	0.010	0.018	0.020	0.168
Silicon	2.800	1.980	1.780	1.726	2.660
Manganese	0.360	0.360	0.398	0.216	0.216
Iron by difference	91.38292	788	92.846	93.018	92.963

TABLE I. TYPICAL ANALYSIS OF CASTINGS POURED FROM BLAST-FURNACE MELT

In the making of castings direct from the blast-furnace melt, the pig bed is prepared in the usual way and the iron which is run into the ladle is the overflow from the last sow. The feeding channel is laid out on an arc with three races going to ladles of from three to four tons capacity. The filled ladles are carried by means of a crane to the foundry building and the molds are poured in the usual way. Many thousands of tons of cast iron are now buried in London clay from 50 to 150 feet below the surface, which were poured from metal obtained directly from the blast furnace. These tunnel segments are 6 feet 7 inches long, 20 inches wide, ⅞ inch thick, with flanges 1⅛ inches thick and 4¾ inches across the face. These segments build a tunnel 11 feet in inside diameter, but some of the tunnels which have been made are as large as 16 feet. Each flange is face milled, the actual cutting time for the machining being 7 minutes. Six of the segments make a complete circle and weigh about 30 hundredweight.

L——, England. W. H. Booth.

A Question in Engineering Ethics

Replying to Entropy's question of ethics in Vol. 30, Part 2, page 979, I would say that he should have charged for his services. What he should have charged I am unable to determine from this distance, but I would have been able to decide if it had been my own case.

Some few years ago I had a similar experience, only I make some claim to a limited knowledge of the particular duty which I was called upon to perform. Even if my previous experience had not covered the particular trouble I was called on to remedy, still from my knowledge of theoretical and practical mechanics in general I would have been able to remedy the trouble and charged for my time just the same.

The machine which I was called upon to fix was a "dinkey" locomotive used in hauling lime rock at a lime kiln up in Pennsylvania. The engineer or driver of this locomotive was a back-woodsman who grew up in the lime-rock mountains, and was a "born mechanic" as the natives said; hence he was given the job of "engineer."

They had enough rock quarried to last the kilns a few days, so the "born mechanic" undertook to repair the dinkey and "put her in good shape." All went smoothly while he was taking her apart and wiping off the grease, which was all he did, or could do, in the line of repairs. When he came to putting her together he was not so successful; she would not start when he gave her steam. Just about that time the kilns had used up the rock they had had ahead and were in a great hurry to get the dinkey running. So the "born mechanic," after he put her together "in better order than she had ever been before since he had been running her,"—so he told me later—was greatly surprised when she wouldn't start.

After he had worked at her until everyone was in dispair the superintendent came to town to see if he could procure the services of someone who could get him out of the dilemma. As I had, just about that time, gained some reputation as a successful "trouble man" I was recommended to him. As a result I went out to the quarry to see what could be done. They had a wooden shed with the regulation locomotive pit so I went down into the pit and looked her over. The "born mechanic" was very profuse in his explanations of what he had done. He had everythinfi just as it was before he "repaired" her and was completely "stumped," because she wouldn't start; "it was one on him;" he had never been stuck before, etc. In addition to other varied experiences I had worked in the pit of the repair shops of the Chicago, Rock Island & Pacific railroad, at Davenport, Iowa, for more than a year. I saw at a glance that he had the eccentric rods on the right hand side connected up contra-wise to the link; i.e., when the lever in the cab was thrown over either forward or backward the forward eccentric on one side was working in conjunction with the backward eccentric on the other side. I asked him to disconnect the eccentric rods from the link on the right-hand side so that I could look them over and see some other parts. While he did as I directed he assured me he had not touched the eccentrics at all, and that they were in the same position on the axle as they were when the engine came from the makers. I did not particularly want to look at the eccentrics, though to do so would do no harm, and on examination they were found to be set on the original shop mark. So I concluded that he had not touched them. What I wanted was to get the rods disconnected from the link without his discerning why I wished it done, and then connect them up correctly. I did this without his knowing the difference.

When I said I thought we would try her he assured me that I was "up against it" this time as he had tried her times without number with no success, and couldn't see what I had done to justify my belief that she would start now. I told him I would be very much disappointed if she didn't start and proceeded to get up in the cab while he followed. I pulled the reversing lever over on the backward motion, opened the throttle a little and out she shot. From the expression on my newlymade friend's face he certainly was astonished.

At the time this incident occurred I was an instructor of machine-shop practice in a technical college, with a salary not half as much as I made before I became a college "professor" nor half as much as I have made since I returned to the ranks of the common people. My friend the "born mechanic" knew I was a professor at the college and being only an unsophistocated backwoodsman he looked upon a college professor as a person endowed by divine inspiration, or otherwise, with a profound knowledge of the occult sciences as well as possessed of other non-understandable skill and learning. He had somewhat of a feeling of deference toward me. To me this was, and is yet, very humorous. Being in a humorous frame of mind myself I thought it would be a sin to disillusion his mind of the profound conception he had of my great importance, so, when he asked me to explain how it was that the dinkey would start for me and not for him when I had done nothing he had not done so far as he could see, I told him that he would not be able to understand any explanation I could give, but that I would not mind showing him by what means I accomplished such results. I had a slide rule in my pocket and I showed it explaining that it was a magic instrument by which those who knew how to manipulate could overcome difficulties seemingly impossible to others. By its use I solved the trouble with his engine; by its use all sorts of problems could be solved, the cycles of the planets, when and why the eclipses of the sun and moon occurred, etc. To prove that what I claimed was true I performed a few simple multiplications which he regarded as truely miraculous. I did not tell him what the trouble was with his engine and do not think I was called upon to do so. I got him out of his difficulty for the time being and restored the engine to its normal condition.

I went to the office, collected my fee and the superintendent drove me back to town. What my fee was I do not care to say but it was eminently satisfactory.

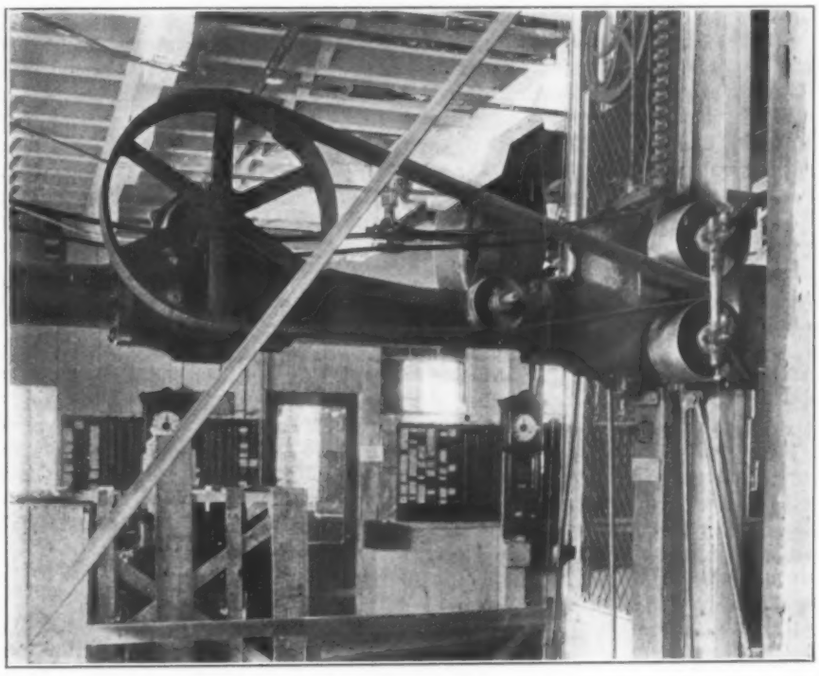
New York City. D. N. Keys.

Commerce of the United States with Germany for the last six months of 1907 in electrical and metal-working machinery amounted to $1,195,079, which is within $5000 of the total in these products for the corresponding period of the record breaking year of 1906.

An Odd Old Elevator

A very odd design for an elevator and one which had been in use over 40 years and is still doing business, is shown with this. It was built for heavy work, is very slow moving but is as steady and safe as an old plow horse. The picture shows half of the "works" which are in the cross beam at the top of the elevator cage. One of the uprights and the supporting rods are shown at the right below the idler pulleys.

The belt is a long endless affair that runs from the cellar to the roof and incidentally takes a side trip between the idlers and over the large pulley at the left which is really in the center of the elevator. This drives a worm which turns a shaft in running through the top casting, connecting by bevel gears with a short worm of large diameter which meshes in the rack shown at the side above the idlers and runs the elevator up or down according to the direction of the belt. It is absolutely safe, being locked by two worms and has given good satisfaction.



AN ODD OLD ELEVATOR

It was built by Campbell & Whittier, of Boston in about 1865, afterward became the Whittier Machine Company and is now a part of the Otis Elevator Company.

For copperplating by simple immersion a solution of 3 pounds of sulphate of copper to 2 fluid ounces of sulphuric acid is recommended by the *Mechanical World*. The surfaces to be plated must be carefully cleaned, so as to be free from dirt and grease. With the above solution it is said good results are certain, and any reasonable desired thickness of plating can be obtained.

Apprentices and Gear Boxes

By John R. Godfrey

Are apprentices out of date and have we reached the point where we no longer need the all-round mechanic as of yore?

I have been talking the matter over with a number of shop managers and others and the general opinion seemed to be that the all-round man was a back number and that apprenticeship in the broad sense was hardly worth talking about. Then I did some thinking on my own hook, or was it just trying to remember what some of them told me? Anyhow there are lots of shops where they only pretend to train boys for one branch and keep them plugging away at that until they quit and go somewhere else for other kinds of work.

One foreman I talked with had no use for machinists, as we used to know them, and I am forced to admit his boys and special men did good work in their line and did it faster than would be the case in many shops, but it didn't exactly dispose of the case.

A boy can learn to run a lathe and become an efficient producer on that tool before he can master the ins and outs of the various machines and methods, but is it to his advantage to do so? He can begin to earn good wages sooner and perhaps make higher wages than the all-round man, but can he always find a job in that line of work?

The training of department foremen is not affected as each department could have a keen man specially trained in that line, but how about a general foreman or superintendent? Would he be picked from any one line or from no line at all, but simply picked up out of a dry goods store because he happened to have that wonderful quality, "executive ability"? We all know that many a good workman is a mighty poor foreman, but is executive ability alone enough to cope with the problems of the shop without any special training in the various departments?

When you get a man to this point he usually admits that we need a few all-round men, but how are we to get them if the shops do not train any for all departments or take no apprentices at all? Isn't it too much to expect that the trade schools can do all this for a young man, and even after the trade school gives him a polish and a diploma, how is he to know that he is fitted for your line of work or you that he is the man you want? Would you put him in charge of a shop without trying him out, and, if not, where will you do the trying? If he gets into one of the specialized departments, the youngest boy there will probably walk all around him in production for a while, and he won't forget it when the new man assumes his titles, dignity, etc., as general foreman of the shop. Neither will he forget to tell the next man that "the new foreman was dead slow in our department," and his respect will not be increased thereby.

How is it going to be done?

Gear Boxes that Were Too Strong

Have you ever had trouble with geared feeds? Well, here was what happened to a lathe maker with as good a gear box as there is on the market. He had been selling lathes to a large concern in the West, and one day his agent came in with a long face saying the superintendent wouldn't buy any more of these lathes. So my friend the lathe maker packed his tooth brush and pajamas in a shoe box and went to see what the fault really was.

The superintendent didn't want to tell him, didn't want to hurt his feelings in the matter, but a lot of persistent inquiry developed the fact that a machinist had been running two lathes, had set one to face down a large disk while he was working on the other lathe. He got so interested that he forget the other lathe, the tool faced down the disk, ran into the lathe center, ruined the tool, the center, and broke some gears. Now the belt feed wouldn't have done that, and he hadn't any more use for this kind of a lathe.

We can all remember how we used to count on the feed belt slipping as a sort of a safety valve, but it is hard to imagine a man who would condemn a machine for such an accident, when the fault is so clearly in the man and not in the machine. But if a lathe with a good, husky geared feed is operated to the limit it will pay better to keep one man on it all the time than to use the belt feed, which never gave the output the lathe was capable of

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Cost Accounting Under Reduced Output

The present condition of machine shops is forcing the proper principles and methods of cost accounting under abnormal conditions upon the attention of manufacturers. Many will say that production under existing conditions is necessarily expensive, that the increased relative charges for administration represent simply increased cost of production, and that cost accounting should go on as in the past, the productive labor being loaded with a heavier burden, which shows itself in the increased cost of the goods.

There is a confusion of ideas here based on the fact that what is called cost in one transaction, becomes value in another. Certainly no one can claim that because goods cost more under present conditions their value has therefore increased. Value is determined by the market and it would be absurd to say that, as determined by the market, the value of machinery is higher today than it was six months ago.

The matter is of importance to the manufacturer in more ways than one, one of these ways growing out of the fact that the change in view point between cost and value takes place in his own works when goods are made for stock. When the cost of goods is calculated the idea in mind is simply that of cost, but if those goods are carried over the date of the next inventory, what was looked upon as cost in the beginning becomes value in the end. Unless a change is made in the cost-accounting method, the goods made during a period of heavy expense will appear as an increased asset in the balance sheet, and if a manufacturer has made enough goods under these conditions, the balance sheet may actually show a state of increased prosperity during a time when common sense tells one that that condition is impossible. In other words, the effect of continuing the cost-accounting methods on previously established lines may easily lead to an inflation of the business.

Of course, any abnormal increase of cost must eventually lead to a loss, and the question to be decided is whether the goods shall be carried on the books at an increased value until they are sold, or whether the loss shall be faced at once by charging the increased cost directly to expense, as it is incurred. To us there seems no ground for argument. To inventory goods produced during abnormal conditions at increased expense, with the expense appearing ultimately in the inventory as an asset, is to invite a showing at the next closing of the books, which is obviously fictitious, and with the error on the wrong, because the dangerous, side of the ledger.

The subject is an old one, but we believe it has never been adequately discussed, or indeed discussed at all. It is now troubling the minds of some of our machinery manufacturers, its turning up at this time being doubtless due to the increased attention which has been paid to the fundamental principles of cost accounting during recent years. An intelligent appreciation of the real principles of cost accounting is of comparatively recent growth, and while that growth has been rapid, there are still many who are pursuing false methods. If the present condition of the machine-manufacturing industry should assist in spreading a knowledge of what true cost is, that might act as a partially compensating advantage.

State-supported Trade Schools

The dominant idea at the recent meeting of the Society for the Promotion of Industrial Education at Chicago, was the inauguration of a vast system of trade schools supported as public schools. There was a certain amount of discussion of a better organized system of apprenticeship with a school attachment, but nevertheless, the major part of the discussion related to a public-school system.

In this discussion there was a distinct line of cleavage, the idea of the educator's party being that these trade schools should be managed on the lines of existing manual-training schools extended and widened in scope, while the idea of the manufacturer's party was that the school shops should be commercial shops. This latter idea was not only voiced repeatedly, but it was received with applause which showed the approval which it met. Let us examine the two alternatives and see where they lead.

We do not believe that schools managed on manual-training lines can be made adequate to the requirements, and we believe that 90 per cent. of manufacturers will agree with us. We consider, in fact, that the manner in which the educational party showed itself wedded to this idea is a demonstration of their failure to comprehend the situation, and of their inadequacy to meet it.

Looking next at the commercial shop school, if these schools are to make something, they must first have something to make. How and by whom is this to be determined? Every commercial machine shop worthy of the name maintains a designing and drafting department for this purpose. Shall such a department be incorporated into these various school shops? The idea is formidable enough, but we see no way of escape from it, for there is no other way known in modern industry for determining the product, and, moreover, if the boys are to be taught the use of drawings, such a designing and drafting department is a necessity.

If the shops are to be, in truth, commercial shops, then, after the products are

made, they must be sold. The products of school shops will not sell themselves any more than will the products of other shops, and for their sale a commercial department will become necessary. In other words, the public-school commercial shop idea leads inevitably to the entering by the state upon a series of full-fledged manufacturing and commercial enterprises. We may be wrong in our conclusion, but to us this spells socialism. From the mere standpoint of expense, the commercial school-shop idea involves all of this. If the products are not to be sold the cost of materials will be tremendous. How, for example are boys to learn the treatment of high-speed steel, except by working on it and how much high-speed steel will the state buy in order to throw it on the scrap heap? In the nature of the case the products of the shops must be sold if the ideas of the manufacturers are to prevail. The essential distinction between a commercial shop and a manual-training shop is that the products of the former are for sale, whereas those of the latter are made for practice and instruction, with the scrap heap as their ultimate destination. If the products are not to be sold the commercial spirit will be lacking and the shops will become mere manual-training shops. Manufacturers must accept the sale of the products or accept a series of schools in which they, rightly, have no faith.

How will manufacturers like it when the products of these shops reach the market? Their quantity will not be negligible. The slogan of the meeting was "give every boy a chance," and if the shops are to be maintained at public expense, this must be carried out. The mechanics produced will have no relation to the needs of manufacturers, but only to the desires of the boys. Shops maintained on this basis must produce a large volume of product. They will in fact act as a two-edge sword, the number of mechanics produced affecting the labor market and the volume of products produced affecting the commodity market. Human nature is much the same in all the walks of life. We do not believe that the manufacturer wants state-made competition in his business, any more than the workingman wants state-made competition in his occupation. Manufacturers object to prison-made goods, and we believe they will object just as strongly to school-made goods. The party which is now clamoring for the establishment of state-supported trade schools will, we believe, clamor with re-doubled force for their suppression as soon as their products enter the market. It is a fundamental dictum of manufacturers that the interest of employer and of employee are identical, and we believe they will find it so with a vengeance should the state supported trade-school idea ever reach fruition. To sum the matter up, we believe that the entire plan of state-supported trade schools must be dropped and the quicker the better.

As we see it shop apprentice schools on the lines of the one established by Mr. Alexander at Lynn, represent the only feasible plan that has yet been developed, and we believe the proper function of the society to be the furtherance of this idea, rather than that of the state-supported school.

This takes the entire movement outside of governmental action so far as it relates to trade schools properly so called. There remains, however, a question for governmental consideration, which is large enough and to which the society can properly devote all the energy available. We refer to the bridging over of the gap between the time when the average boy leaves school and the time when he is wanted in the shops, that is between the ages of 14 or thereabouts and 16 or 17. Throughout the discussion, there was constant confusion between this problem and the problem of trade schools properly so called. They were, in fact, often discussed as one and the same problem, whereas in fact they are as distinct as two problems can be. The problem of the trade school is largely a manufacturer's problem, whereas the problem of inducing the boys to remain longer at school is chiefly an educator's problem. No doubt, the manufacturers can assist the educators, but that is no reason for failure to recognize the distinction.

American Supply and Machinery Manufacturers' Association

A joint meeting of the committees appointed from the American Supply and Machinery Manufacturers' Association, National Supply and Machinery Dealers' Association and the Southern Supply and Machinery Dealers' Association was held at Richmond, Va., January 24, the purpose of which was to arrange for the joint annual convention which is to be held in Richmond, May 13, 14 and 15 next.

Convention of American Foundrymen's Association

The 1908 convention of the A. F. A. is to be held in Toronto the second week in June, in conjunction with the allied organizations, the Brass Founder's Association and the Foundry Supply Association. The facilities offered at Toronto for a convention and exhibition of this kind are considered by those in charge of the arrangements as excellent and indications point to a successful convention, from the various points of view. The exhibit buildings are ample to meet all requirements and the Auditorium which is to be used for the reading of papers and discussion of subjects presented is well situated. Machinery Hall is equipped with shafting, and both direct and alternating current for power and lighting purposes. Provision will also be made for compressed air and water. The floor is tight and strong, and well suited for the support of heavy machinery.

H. M. Lane, secretary, is in possession of complete information concerning all features of the convention and can be reached by addressing him at 1924 Prospect avenue, Cleveland, Ohio.

Annual Dinner of the A. I. of E. E.

The annual dinner of the American Institute of Electrical Engineers will be held at the Waldorf-Astoria, Thirty-fourth street and Fifth avenue, New York City, on the evening of Wednesday, February 19, at 7 o'clock. Carrying out the idea established upon former occasions, the feature of the dinner this year will be the tribute rendered by the speakers to the relation of the electrical engineer with public service corporations. The occasion will be designated as the "Public Service Dinner."

Personal

Charles A. Bacweister has been appointed Western representative of the Monarch Emery and Corundum Wheel Company, with headquarters in Chicago.

A. D. Finley, until recently with the E. J. Manville Machine Company, has accepted the position of associate engineer with the Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.

A. E. Linendoll, for some time connected with the Gisholt Machine Company, has accepted a position in the engineering department of the Jacobson Machine Manufacturing Company, Warren, Penn.

J. W. Duntley, president of the Chicago Pneumatic Tool Company, sailed from New York on February 4. Mr. Duntley expects to remain in Europe four or five weeks in the interests of his company.

E. T. Sederholm recently joined the organization of the Nordberg Manufacturing Company, Milwaukee, Wis., and is filling the position of assistant chief engineer. Mr. Sederholm has held a consulting practice in California for the last five years, previous to which time he was connected with the Allis-Chalmers Company.

C. Kemble Baldwin is at present associated with Thomas Robins, inventor of the Robins system of belt conveying, in the formation and organization of the Robins New Conveyor Company. Mr. Baldwin was formerly chief engineer of the Robins Conveying Belt Company and will act in the same capacity for the new company.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Combination Tool Holder

The illustrations show a general utility tool holder in which provision is made for straight turning or shaping, side, cutting-off, boring, threading and keyseating tools. Fig. 1 shows the holder with a side tool in position. The square hole in the center can be used for either square or round turning or boring tools. Fig. 2 shows the tool with extension for keyseating.

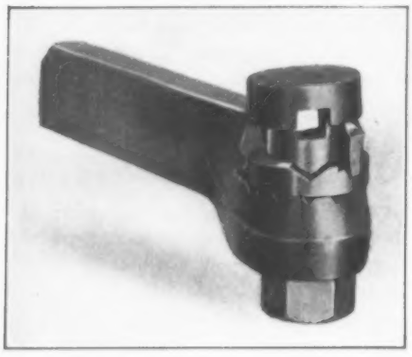


FIG. 1. A COMBINATION TOOL HOLDER

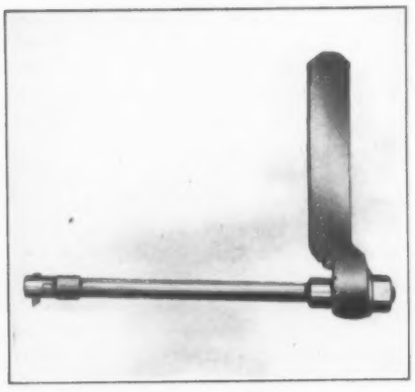


FIG. 2. KEYSEATING TOOL

This tool holder is made by the Western Tool and Manufacturing Company, Springfield, Ohio.

Ball Bearing Universal Joint

We illustrate herewith what appears to be an entirely new method of making universal joints, and which seems to be both novel and substantial. The joints consist of two plates, two forks and eight balls. In Fig. 1 a fork has been passed through the plates from the back until the four balls could be dropped into place, and then pulled back so that the balls fit into their seats. After the other fork has been placed in its plate, the two plates are bolted together and the forks are held in place by the balls, as shown in the sectional portion of Fig. 2.

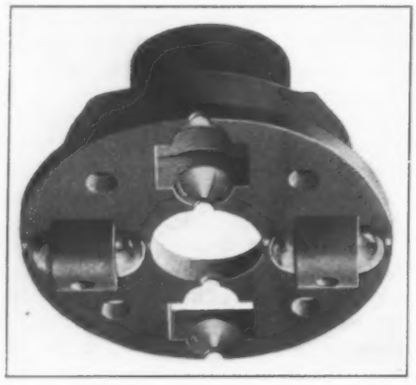


FIG. 1. HALF OF THE JOINT

This makes a very strong joint as the plates completely support the forks and prevent their spreading under the most severe strain, and durability is insured by having both plates and forks made from drop forging. In addition to this all working parts are hardened. When wear occurs from long use all that is necessary is to take the joint apart and grind off the faces of the plates. This allows the two plates to be bolted together so as to take up all wear, which is sure to be slight, in view of the fact that all ball seats are grooved to insure perfect lubrication.

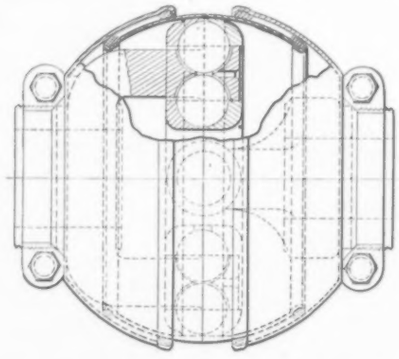


FIG. 2. SECTION THROUGH THE BEARING

Fig. 2 shows the cover which surrounds this joint and keeps the dust out and the oil in. It also presents a practically smooth surface, which is at once more sightly and safer than the open joint.

Although designed primarily for automobile transmission requirements, it is equally useful in machine shop work and can be used to advantage in connection with boring bars and adjustable drills. This ball bearing universal joint is made by the Kinsler-Bennett Company, Hartford, Conn.

A Recording Water-level Gage

A recording instrument, developed primarily for charting the depth of water over weirs, in tanks, reservoirs, canals, etc., but which has a most useful application in connection with oil tanks and the like for manufacturing plants, is illustrated by the accompanying half-tone engraving. It consists of three parts—the air-bulb, or bell, which is immersed in the liquid the level of which is to be recorded, a flexible copper tube connecting this bell with the recording instrument, and the instrument itself. The instrument uses a circular paper dial upon which a record is charted by an inked pen, and resembles in its general outline and characteristics the other recording instruments produced by the firm which makes it, the Bristol Company, of Waterbury, Conn.

A RECORDING WATER-LEVEL GAGE

The bell consists of an upper and lower bronze casting, indicated by the letters *E* and *C*, respectively. Between their companion flanges is firmly held a flexible diaphragm of thin sheet rubber, convexing downward, and inclosing the proper

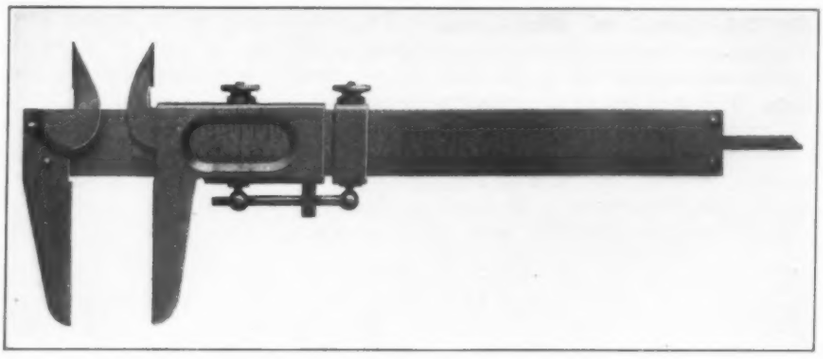
amount of air for the operation of instrument. Near the bottom of the lower casting *D* are several holes for admitting water. The pressure of this water acts on the rubber diaphragm and transmits to the inclosed air a pressure corresponding to the head or the depth below the surface. This air pressure is transmitted to the recorder by the capillary tube *B*. The air-bulb or bell can be suspended at a proper hight in the liquid by means of a cable, as at *G*, or it can be firmly fixed to a support by means of a clamp, as indicated by *C* and *F*.

When used for recording the surface level or contents of oil tanks an air-bulb slightly different from the one illustrated is used. The feature which is changed is the rubber diaphragm. This is eliminated because of the deterioration to which it would be subjected when immersed in the oil.

As the air-bulb is placed below the surface of the liquid it is not affected by cold weather, and, as the connection between it and the recorder is by means of the flexible capillary tube, the recorder can be located at a distance in any convenient place desired. A variety of charts can be supplied which will read feet or inches of head, feet or inches of depth above or below a given datum, or, in the case of a tank, the volume of cubic feet. This latter feature is of especial value in connection with fuel-oil tanks.

German Vernier Caliper and Depth Gage

The accompanying half-tone illustrates a vernier caliper and depth gage, the jaws of which are obviously adapted for both outside and inside measurements. The scales at top and bottom of the beam in conjunction with the vernier read to 1/128 and 1/1000 of an inch, respectively. The narrow slide projecting from the end of the beam and used as a depth gage is carried in a slot at the rear of the beam, its inner end being attached to the sliding caliper jaw, so that its settings are also made by the vernier scales. A thin flat spring at the back of the sliding jaw holds the latter in contact with the beam at all times, but allows the jaw to be readily adjusted when the clamp screw is released. The capacity of the tool shown is four inches for external and internal measurements, and also four inches for depth. It is of German design and construction and handled in this country by the New Metal Tool Steel Company, 25 Franklin street, Portland, Me.



GERMAN VERNIER CALIPER AND DEPTH GAGE

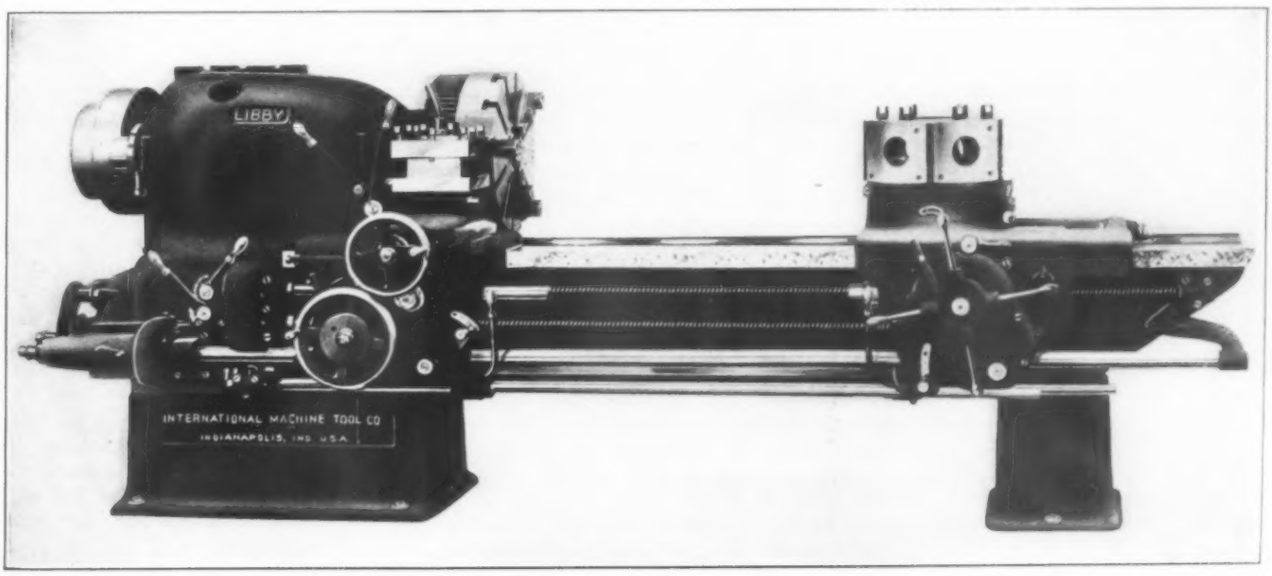
The Full Swing Turret Lathe

This lathe has several features which mark it as different from any of the other turret lathes. It is the design of Charles L. Libby, and is being built by the International Machine Company, of Indianapolis, Ind.

As can be seen from the illustration, the work can have full swing over the carriage and this gives its name. With the carriage run past the chuck jaws the turret can work as close as desired, and all overhang of tools reaching across the carriage is avoided. The carriage does not extend across the bed, but is supported by the front way of the bed and a V guide at the bottom of the apron. A long taper gib at the inside of the car-carriage takes up all wear.

Both the carriage and turret slide have independent feed screws and the feeds are entirely independent in direction. Both have quick traversing device independent of the other, so that one can be feeding and the other traversed in either direction at the rate of 25 feet per minute. Both can cut threads up to one-inch pitch, and there are eight changes of feed through feeds and eight more changes by change gears vary the feed from one inch down to 1/200 inch per revolution of spindle. The carriage cross-feed screw has the same lead as the main screw.

The turret head is supported by a spring pivot bearing, adjusted to the load of turret and tools, which relieves the friction on the annular bearings and allowing the turret to be swung very easily. The turret lock pin and the clamping device are both



LIBBY FULL-SWING TURRET LATHE

operated by the same lever. This releases or locates the turret in position and a further movement clamps it rigidly at its outer edge. Automatic stops are provided for all feeds, and in connection with them there is an indicator which shows at all times the exact position of the cutting tool. This helps in securing work that is exactly duplicate.

The turret apron is geared to give only one-half inch movement to the slide for one revolution of the pilot-wheel, which gives the operator sufficient leverage to handle a heavy facing cut without undue strain.

The headstock is of the geared type with all gears inclosed, and the two levers control the speed changes from the gearing. These give four speeds, and with the two changes by the cone pulley and three changes from the countershaft, makes a total of twenty-four changes, all in geometrical progression and running from 5 to 180 revolutions per minute. The head is designed so that any two-to-one type of electric motor can be used to drive it at any time, so that a purchaser can make the change any time that suits his convenience.

There is also a boring-bar support at the back of the machine so arranged that while this support is being used the carriage can be used for turning as though it were not there. Oil pans and pumps are furnished for working in steel.

The lathe shown swings 20 inches over carriage, has a turret traverse of 60 inches, 3½-inch holes in turret, a 3⅝-inch hole in the spindle and weighs 9000 pounds.

Consul James H. Worman, of Three Rivers, reports that the Grand Trunk Railway, of Canada, has placed orders for 90 new locomotives, involving an expenditure of nearly $2,000,000, of which about one-fifth will go to the United States. These locomotives will be built in time for the movement of next season's wheat crop. A Toronto concern will furnish 20 simple road engines, a Longue Pointe machine company 30 of the same class and 20 Richmond compound consolidated engines, while 10 switch engines and 10 ten-wheel passenger locomotives will be furnished by the Baldwin Locomotive Works, of Philadelphia.

The first 60,000-volt hydro-electric plant in Japan has just been put into service by the General Electric Company, after having passed the rigid inspection which is required by the Japanese Government of all electrical installations. Power is obtained by impounding the Ugigawa river, a narrow and swift, but deep river, such as is often found in the mountainous portions of Japan. The normal capacity of the main station is 18,000 kilowatts, and is furnished by six 3000-kilowatt, 50-cycle, 6600-volt water-wheel-driven alternators.

Laying Out Parabolic and Elliptical Templets

By Walter Gribben

A job that recently fell to my lot may prove of interest to those of your readers who are mathematically inclined. The job in question was o turn a parabolic silver cone *a b c d*, Fig. 1, the axis *e f* of the cone being parallel to the axis *h m* of the parabola but not co-incident with it. The focus of the parabola was at *p*, *h r* being a line through the vertex of the parabola and at right angles with the axis. The cone had to be turned to as close an approximation to a true parabola as possible, and to have a mirror finish. The only way I knew of to do this work was to make a parabolic templet and use this to try on the work while I turned it free hand.

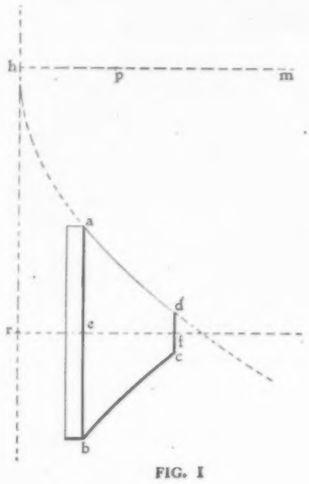


FIG. 1

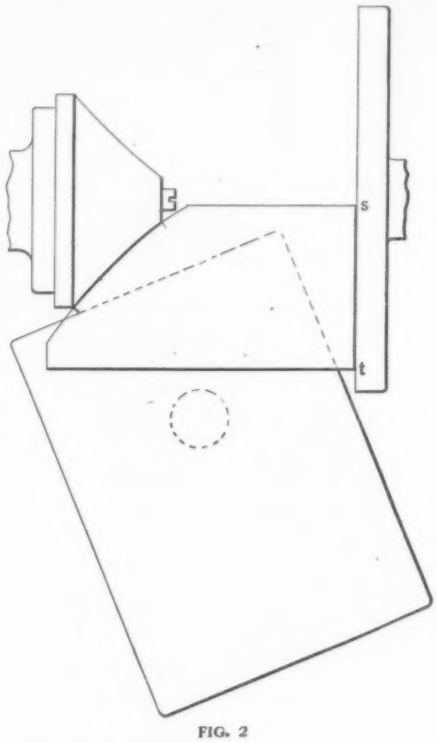


FIG. 2

A PARABOLIC CONE AND ITS TEMPLET

The distance between the axis of cone and parabola was given, also distances *e r*, *h p* and the diameters *a b* and *c d*. The blue print that was furnished me contained the equation of this parabola referred to the lines *h r* and *h m*, which was $y^3 = 3.6\ x$, which means that in this particular parabola the square of the distance of any point on the parabola from *h m* is equal to 3.6 times its distance from *h r*.

I have a vertical slide with micrometer screw feed, which goes on my slide rest and ordinarily carries a milling spindle. This spindle and its bearings were removed, leaving the flat seat of the swivel plate exposed. On this I clamped the piece of sheet brass from which the templet was to be made. This stood crosswise of the lathe and could be raised or lowered a measured amount by the vertical screw, and also moved horizontally by the cross-feed micrometer screw, while the longitudinal slide served to bring the sheet brass in contact with a very sharp center punch held in a wire chuck, the lathe spindle being locked to prevent rotation.

The computations for the lay-out were made as follows: A series of 16 points on the parabola was chosen, the first one being 1.5 inches from *h m*, and each successive point being 0.050 inch farther away, the last one being 2.25 inches from that line. These points were thus chosen so that the first and last points would lie a little beyond the portion of the parabola that was to be used for the profile of the cone. By squaring each of these assumed distances and then dividing each by 3.6, the corresponding distance of each of the chosen points from *h r* was obtained.

Thus having the distance of each point on the parabola from the two lines *h m* and *h r* at right angles to each other, it was a comparatively simple matter to lay off the templet by moving the vertical screw 0.050 inch between the successive center punchings, and also moving the cross slide by an amount equal to the difference between the points as measured from *h r*. It was not neces-

sary to scribe the lines $h\,m$ and $h\,r$ on the templet; but while the templet was still on the slide rest I scribed a line parallel to $h\,r$, without regard to its absolute location, by letting the center punch lightly touch the brass and then moving the vertical screw. By filing the templet to this line, shown at $s\,t$, Fig. 2, it could be held against the drill plate in the lathe while applying the templet to the cone, thus insuring the axis of the parabola being parallel to the axis of the cone. There were two marks made on the templet where it was to come against the ends of the cone, so as to make sure that the right position of the curve was being used. In order to get the plane of the templet to intersect the axis of the cone while it was being applied, the templet was laid on a flat table whose stem fitted to the hand-rest socket, this table being adjusted to such hight that the middle of the thickness of the templet came at the hight of the center. As this table and the regular T-rest had to be used alternately in the hand rest socket, a short piece of brass tubing was cut to proper length and placed loosely on the stem of the table so it would always come at the correct hight without any time being wasted in adjusting it. A little coloring matter was rubbed on the templet to show where it touched the cone and so tell me where to turn it off with the graver.

On this same job, only a later edition of it, there was a call for two elliptical templets, and these presented more difficulties for two different reasons, viz.: The equation of an ellipse is more complex than that of a parabola, making the computations more extensive; also the major and minor axes of both these ellipses stood obliquely relative to the vertical and horizontal elements of the instrument for which they were made.

One of the elliptical templets is shown at $a\,b\,c$, Fig. 3. It was to embrace a portion of an ellipse near the extremity of the minor axis and was to have drilled in it the three holes $d\,e\,f$, in which to insert plugs to locate properly the templets after it was made. The foci of the ellipse was at $F\,F'$.

There are at least four different equations of an ellipse, according to what lines the reference is to be made; but the one I thought would best suit my purpose was where the vertical measurements were taken from the major axis $h\,m$, and the horizontal measurements from the line $h\,r$, which is perpendicular to the major axis at its left-hand extremity. The equation I used was $y^2 = \frac{B^2}{A^2}(2\,A\,x - x^2)$, where A is half the major axis, B half the minor axis, x the distance of any point in the ellipse from $h\,r$, and y the distance of the same point from $h\,m$. I selected 31 values for x, ranging from 2.55 to 4.05 inches, varying by 0.05 inch, and from the formula computed the corresponding values of y. After this I pricked off the different points on the curve in a similar manner to that used in laying out the parabola.

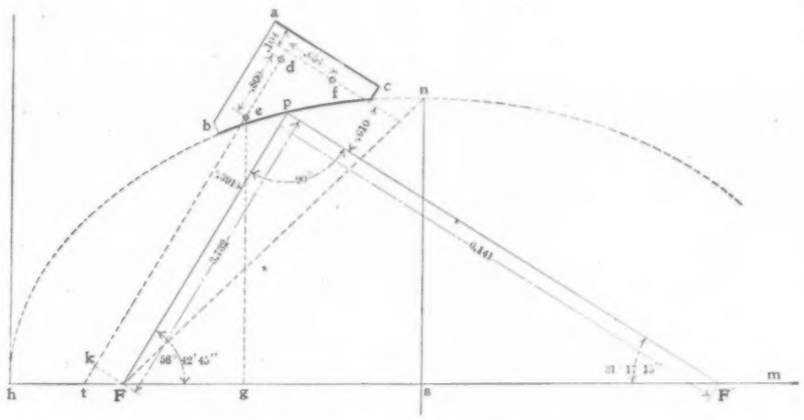


FIG. 3. LAYING OUT AN ELLIPTICAL TEMPLET

The two lines drawn from p, the middle of length of the templet curve to the foci $F\,F'$, and also the sides $a\,b$ and $a\,c$ of the templet, were parallel to the vertical and horizontal members of the instrument in which it was to be used. The location of the holes d, e and f was known in relation to $p\,F$ and $p\,F'$; but in order to lay them out at the same chucking with the prick-punch marks on the curve itself, it was necessary to know the relation of these holes to the lines $h\,m$ and $h\,r$. As $p\,F\,F'$ is a right-angled triangle with the two sides $p\,F$ and $p\,F'$ given, we can divide one known side by the other and get the tangent and cotangent of the two acute angles, which we find to be 31 degrees, 17 minutes, 15 seconds, and 58 degrees, 42 minutes, 45 seconds. By extracting the square root of the sum of the squares of the two known sides, we get the hypotenuse $F\,F'$, which we find to be 7.128 inches, half of which is $F\,s$. By the properties of the ellipse we know half of the sum $p\,F$ and $p\,F'$ is equal to $F\,n$, and also to $h\,s$, which we find to be 4.936 inches. By extracting the square root of the product of the sum and difference of $F\,n$ and $F\,s$, we get $s\,n$ which we find to be 3.387 inches. By subtracting $F\,s$ from $h\,s$, we get $h\,F$, which we find to be 1.345 inches. By drawing $e\,g$ square with $h\,m$, and $F\,k$ square with $e\,t$, we get two triangles $g\,t\,e$ and $k\,t\,F$ that are similar to $p\,F\,F'$ and therefore have the same angles. In the small triangle $k\,t\,F$, if we multiply 0.391 by the tangent of 31 degrees, 17 minutes, 15 seconds, we get $k\,t$, which we find to be 0.238 inch; dividing 0.391 by the cosine of 31 degrees, 17 minutes, 15 seconds, we get $t\,F$, which we find to be 0.458 inch.

To solve the triangle $g\,t\,e$, we add together $k\,t$, $F\,p$ and 0.610, and from this sum subtract 0.904, which gives us $e\,t$ equal to 3.676; multiplying this by the sine of 58 degrees, 42 minutes, 45 seconds, we get $e\,g$, which we find to be 3.141 inches. By multiplying $e\,t$ by the cosine of 58 degrees, 42 minutes, 45 seconds, we get $t\,g$, which we find to be 1.909 inches. By adding $t\,g$ and $h\,F$ together and subtracting $t\,F$, we get $h\,g$, which we find to be 2.796 inches. In a similar manner the distances of the holes d and f from $h\,m$ and $h\,r$ were found.

In filing up the curve of the templets to the row of fine center-punch marks, I was greatly aided by examining the templets under the compound microscope, as in this way I was enabled to work about 40 times as close to the marks as I could with my naked eye, the microscope in this case being used in its magnifying capacity only, and not as a measuring instrument.

Alaska-Yukon-Pacific Exposition

Work on the grounds and buildings of this exposition, which is to be held from June to October, 1909, at Seattle, Wash., is reported to be well under way. Contracts have been let for the construction of five large buildings and several smaller ones. Among these are the Manufacturers Building, Agricultural Building, Auditorium, Palace of Fine Arts and Machinery Hall. The three latter buildings will be permanent structures. The purpose of the exposition, which is to exploit Alaska and Yukon, and the countries bordering on the Pacific Ocean, is receiving considerable favorable comment.

According to a statement published in the principal commercial journals of Russia, and supplied by Consul-General Richard Guenther, of Frankfort, the value of agricultural machines and implements annually imported by Siberia amounts to about 10,000,000 rubles ($5,150,000). The imported articles are chiefly supplied by German and American manufacturers, being far superior to those made in Russia.

A Rivet-heating Furnace

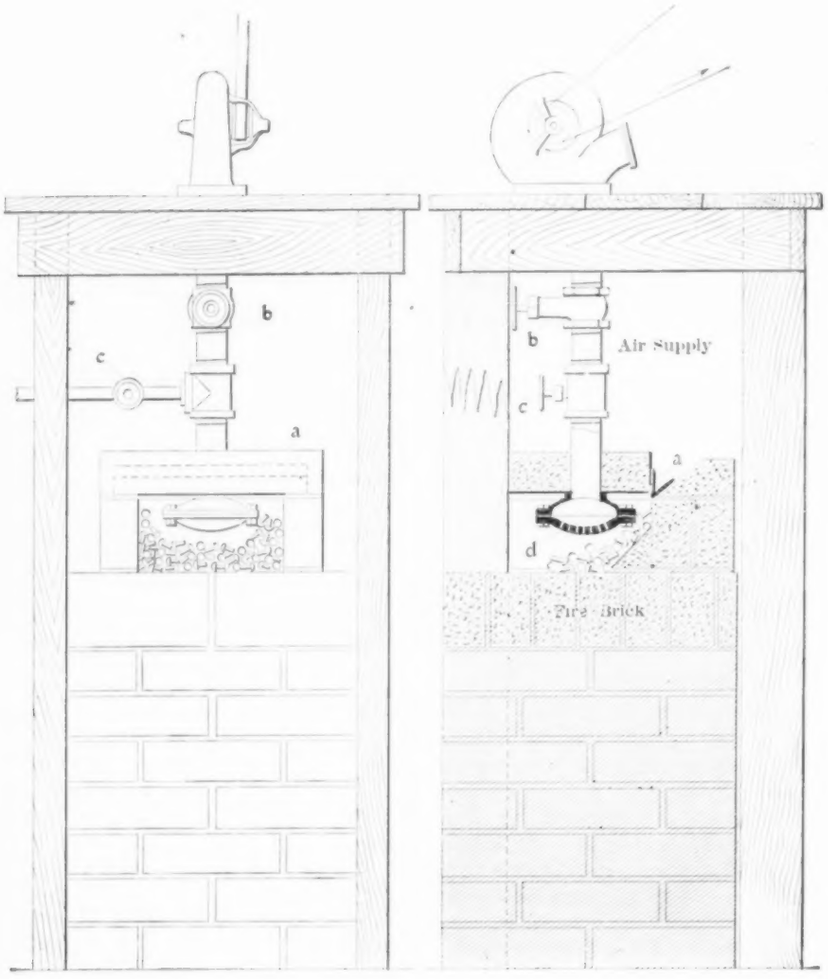
By Edward Balbach

The accompanying sketch shows the front elevation and cross-section on the center line of a simple furnace for heating rivets. The setting is very substantial and can be installed at a slight cost, the largest item of expense being the small forge fan for supplying the blast.

The air supply from the fan, which is a 12-inch one, can be regulated by means of the valve *b*. The gas enters through valve *c*, which acts as a medium of control. Air and gas combine in the lower part of the air pipe and in the burner *d*, from which it issues in a downward direction. The fire box is constructed of fire brick and has an open front, also a small opening in the rear, which is covered by the V-shaped plate marked *A* in the sketch.

The rivets are dropped through this latter opening and roll down the inclined inner rear surface of the furnace to a position under the burner. They can thus be fed in gradually; as the flame can be controlled to give the proper temperature, the rivets can be heated to the proper degree without danger of burning them, as often happens in a hand forge.

No special attendant is required to watch the rivets after the flame is once adjusted. This furnace has been in operation for some time, giving entire satisfaction.



FURNACE FOR HEATING RIVETS

Business Items

The firm of Chas. A. Schieren & Co., New York, has been incorporated under the name of Chas. A. Schieren Company, the members of the old firm constituting a controlling interest in the new corporation.

The Fulton Machine and Vise Company, of Lowville, N. Y., manufacturer of universal swivel vises, has made arrangements with Surpless, Dunn & Co., of Murray street, New York, and Canal street, Chicago, Ill., to become its sales agents. The new shop in Lowville, rebuilt after the fire last spring, is now in full operation.

Henry Docker Jackson, consulting electrical engineer, of 88 Broad street, Boston, Mass., states that business in New England is reviving and that he is now figuring on a number of new deals. He has just completed a report on the conditions existing at the plant of the Mayo Knitting Machine and Needle Company, Franklin Falls, N. H., with particular reference to the power requirements and methods for improving the economy of operation.

Trade Catalogs

The Standard Steel Works, Philadelphia, Penn. Catalog of springs for railway and electric traction service. Illustrated, 36 pages, 6x9 inches, paper.

Lea Equipment Company, 136 Liberty street, New York. Booklet describing the Lea-Simplex cold metal saw. Illustrated, 16 page, 3½x6 inches, paper.

Miami Valley Machine Tool Company, 841 West Germantown street, Dayton, O. Booklet describing lathes and sensitive drills. Illustrated, 12 pages, 3½x6 inches, paper.

Fulton Machine and Vise Company, Lowville, N. Y. Catalog of the F. & R. universal, vertical and horizontal swivel vise. Illustrated, 14 pages, 3½x5½ inches, paper.

Cutler-Hammer Clutch Company, Milwaukee, Wis. Booklet entitled "Lifting Magnets and Recent Improvements in Them." Illustated, 30 pages, 3½x5 inches, paper.

Jenkins Brothers, 71 John street, New York. Supplement superseding pages 70 and 71 of 1907 catalog on extra heavy and medium pressure gate valves. Illustrated.

Sebastian Lathe Company, Box 729, Cincinnati, Ohio. Catalog No. 12 of engine and foot lathes, speed lathes, lathe sets, tools and attachments. Illustrated, 36 pages, 6x9 inches, paper.

Tudor Manufacturing Company, Taunton, Mass. Part Catalog No. 1, describing Bay State labor saving tools, including ratchet wrenches and clamps. Illustrated, 16 pages, 3½x6 inches, paper.

B. F. Sturtevant Company, Hyde Park, Mass. Bulletin No. 152 explaining operation of the Sturtevant high pressure blower. Illustrated, 8 pages, 6½x9 inches. Bulletin No. 100 for February, which is the second number of Daily Cupola Record and which is supplied gratis.

Manufacturers

The Iowa Furnace Company, Des Moines, Iowa, is erecting a new building.

Thompson Bros., Salisbury, N. C., will establish a garage and machine shop.

The plant of the Purcellville (Va.) Foundry Company was destroyed by fire.

The Page-Hersey Iron Tube and Pipe Company, Welland, Ont., will enlarge its plant.

John Weinhardt, Cincinnati, Ohio, is to start a new brass foundry at 2129 Barnard street.

Fire damaged the plant of the Seneca Chain Company, Kent, Ohio, to the extent of $15,000.

The Pueblo (Colo.) Carriage Company will enlarge its plant and install some new machinery.

The Badger Box and Lumber Company, Grand Rapids, Mich., has begun the erection of a new saw mill.

Thomas B. Jeffery & Company, Kenosha, Wis., makers of the Rambler automobiles, will enlarge their plant.

F. Meyer Bros. & Company, Peoria, Ill., hardware and stove manufacturers, will erect a two-story addition.

The Price-Evans Foundry Company, Chattanooga, Tenn., will erect an addition to main foundry building.

The Davenport (Iowa) Wagon Company, which makes a specialty of steel farm wagons, will build a new plant.

The Fravel Sash and Door Company, Harrisonburg, Va., will add new machinery and make various improvements.

The Perfection Road Machinery Company, Galion, Ohio, a new concern, capitalized at $200,000, will erect a factory in the spring.

The Wallace Barnes Company, Bristol, Conn., manufacturing steel clock springs and specialties, will erect a three-story addition.

Riddings Bros., Buena Vista, Va., will establish a branch plant at Lexington, Va., for the manufacture of sash, doors, brackets, etc.

Plans have been made for increasing the plant of the American Can Company, at Sharon, Penn., to three times the present size.

The Stahl Glass Company, Greensburg, Penn., will reconstruct the plant recently destroyed by fire. About $100,000 will be expended.

F. E. Moore, of the Sterling Stove Manufacturing Company, Pittsburg, Penn., is considering establishing stove works in Tulsa, Oklahoma.

It is reported that the United States Steel Company is planning to establish at Lorain, Ohio, one of the largest steel rail mills in the country.

The large tin plate plant at Morrisburg, Ont., operated by J. Wesley Allison, was destroyed by fire. Loss about $75,000. It will be rebuilt.

The planing mill and lumber yard of W. S. & A. M. Culp at Chestertown, Md., was burned entailing a loss of $15,000. The mill will be replaced.

The pattern shop and armature works of the Cleveland Steel Casting Company, Cleveland, Ohio, were destroyed by fire, causing a loss of over $200,000.

It is stated that the American Concentrator Company, Joplin, Mo., manufacturing mining machinery will establish a branch plant in Waynesboro, Va.

The Maysville (Ky.) Foundry and Engineering Company has been incorporated with $50,000 capital stock by E. P. Browning, S. P. Browning and J. W. Fitzgerald.

The United States Vailograph Company, Minneapolis, Minn., will erect a factory for the manufacture of an improved vibrator used in connection with wireless messages.

The Universal Crusher Company, Cedar Rapids, Iowa, a newly incorporated concern, will erect a plant for the manufacture of crushing machinery. A. H. Newman, president.

The Bettendorf Axle Company, Davenport, Iowa, has erected a new machine and blacksmith shop, 380x50 feet which is to be equipped with modern machinery and conveniences.

The Standard Steel Car Company, Pittsburg, Penn., will double the capacity of the plant at New Castle, Penn., which was recently purchased from the Shelby Tube Company.

The Love-Cochran Manufacturing Company, Greensboro, N. C., has been incorporated with $15,000 capital to manufacture buckets, step-ladders, washboards, etc., by W. E. Cochran, E. C. Love, etc.

The Holland Development Company has been incorporated with $1,000,000 capital stock to construct railways operated by steam and electricity and to erect power plants. Offices are at 1 Exchange Place, Jersey City, N. J.

Plans have been drawn for a new erecting shop for the New York Central & Hudson River railroad at West Albany, N. Y., to cost about $200,000. It is also reported that a new machine shop, to cost $250,000, will be erected in the near future.

A. W. Harding, interested in the Fayetteville (Ark.) Iron Works, will incorporate the Ardmore Foundry, Machine and Bridge Company and will establish at Ardmore, Okla., a general foundry and machine works and also manufacture engines, boilers, railroad appliances, etc.

The Pilling Air Engine Company, of Detroit, Mich., manufacturers of pneumatic hoists and compressed air hoisting machinery, etc., will change its name to the Detroit Hoist and Machine Company, a new corporation with $50,000 capital stock fully paid. The Pilling corporation will be retained with a nominal capital to protect the name and good will. Both companies will be controlled by the same management. The company has just installed and is now operating its new plant. Other improvements will be added in the near future.

Want Advertisements

Rate 25 cents a line for each insertion. Abut six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value shoud not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry and Parker, Erie, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Want one copy each of November and December issues weekly AMERICAN MACHINIST. Box 863, AMERICAN MACHINIST.

Special machinery designed and built; duplicate parts, tools, jigs and dies. The Wade Machine Co., 133 Oliver St., Boston.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Special machines designed and built; duplicate parts, model or experimental work. Mantle, Park ave. and 129th St., New York.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Inventions, novelties, ideas, etc., developed; special machines designed. Albert Pott, M. E., 23 Platt St., New York, and Waterbury, Conn.

Air, ammonia compressors, steam, gas engines, turbines, centrifugal pumps, special machinery designed; inventions developed. Box 814, AMERICAN MACHINIST.

Chauffeurs earn good wages; call and take a trial lesson at our garage; we do not wish you to enroll unless you like our method of instruction; booklet free. Automobile School, 754 South Broad St., Philadelphia.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MAHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Want to buy outright, small machine shop with complete equipment manufacturing some meritorious article or machine; same commanding a good market; must stand thorough investigation; state conditions fully. Box 848, AMERICAN MACHINIST.

In evenings, invent for profit; mail invention for free advice, and cost to obtain a patent; popular prices; open day and evening. Edward P. Thompson, M. E., registered patent attorney, member A. S. M. E., and A. I. E. E., 50 and 53 Morningside Ave., West, New York, via subway to Columbia University station.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Designer wishes to make a change; experience in automatic tool machinery, jigs, fixtures and tools; is not particular about location. "R. J.," AMERICAN MACHINIST.

Foreman of toolroom or intricate manufacturing; 17 years' experience, 9 years as foreman of toolroom and manufacturing; first-class designer of tools; can furnish best of reference as to mechanical and executive ability. Box 856, AMERICAN MACHINIST.

ILLINOIS

Assistant superintendent manufacturing plant 3 years; 5 years' previous experience in machine shop and drafting room; 32 years old; Yale graduate; member of A. S. M. E.; location, in or near Chicago. Box 732, AMERICAN MACHINIST.

Mechanical engineer, 31, German, in responsible position is considering change; four years shop, 6 years construction, consulting and executive; college graduate; Chicago or vicinity preferred, not material; sheet metal working, steam, gas; $3000. Box 860, AM. M.

MASSACHUSETTS

Position as superintendent or assistant; 17 years' experience as machinist, chief draftsman, assistant superintendent and mechanical engineer; familiar with best present day methods; practical, systematic and energetic; successful shop organizer and manager of men; age 36. Address Box 861, AM. MACH.

NEW JERSEY

Practical man; 30; assistant superintendent 6 years, drop forge business; do drafting, estimating, etc.; advancement. Box 851, AMERICAN MACHINIST.

Situation wanted; thorough mechanic; good executive and a first class designer of automatic machinery; reasonable salary; will go anywhere. Address "Tact," AM. MACH.

Foreman blacksmith who thoroughly understands all kinds of machine forging, hardening, etc.; will be open for engagement soon; reference, past employers. Box 854, AM. M.

NEW YORK

Mechanical draftsman wishes position. Address Box 840, AMERICAN MACHINIST.

Two first-class all-around machinists, many years' experience on tools and experimental work wish steady position. Box 859, AM. M.

Instrument and toolmaker; good constructor and draftsman; experienced on manufacturing and experiments; wants change. Box 855, AMERICAN MACHINIST.

Mechanical engineer; 10 years' experience; desires assistant chief engineers' or draftsmans' position; terms moderate; location, no object. Box 849, AMERICAN MACHINIST.

Machinist and toolmaker; expert in all branches; 16 years' experience, 5 years as foreman; inventive; wants position; highest references. Box 862, AMERICAN MACHINIST.

Foreman toolmaker or master mechanic desires change; location Greater New York or vicinity; expert on tools, jigs, fixtures and special machine design; well up in modern shop; practical and successful handler of men; reasonable salary. Address Box 842, AMERICAN MACHINIST.

OHIO

Situation Wanted—Mechanical engineer; successful as a practical inventor and constructing engineer; experienced in gas, refrigeration, air, steam and hydraulic engineering, etc.; has invented and developed large variety of machinery now in general use; advertiser is a university graduate; a practical machinist; has had twenty years' experience in mechanical engineering; is of course now fully occupied, but desires to make a change for good reasons, and invites correspondence; only the highest class position in the engineering sense is desired; any location satisfactory. Box 847, AMERICAN MACHINIST.

PENNSYLVANIA

Toolmaker, machinist ,wants position. Box 837, AMERICAN MACHINIST.

Mechanical engineer and draftsman; college graduate; all-around man; 8 years' experience in designing of machinery and plants; desires to change present position. Box 864, AMERICAN MACHINIST.

Engineer skilled in designing and constructing machinery for rapid production desires position of responsibility with concern manufacturing duplicate parts in large quantities. Box 857, AMERICAN MACHINIST.

VIRGINIA

Foundry foreman; first-class man; wide experience on a large variety of work; desires position; 44 years of age. Box 858, AM. M.

Help Wanted

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS

Wanted—As storekeeper, receiving and shipping clerk; a capable man who has had similar experience; Cell Drier Machine Co., Taunton, Mass.

NEW JERSEY

Wanted—First-class mechanical superintendent for a printing machine plant near New York; must have executive ability, up-to-date methods and be capable of producing best results at lowest cost; state age, experience and salary expected. "Permanent," AMERICAN MACHINIST.

Wanted—First-class, experienced salesmen to sell printing machinery in New York City and New York State; also one to travel in other States; only men of ability and mechanical experience need apply; applicants must state full particulars, age and salary desired. Confidential, AMERICAN MACHINIST.

Wanted—Boiler room foreman capable of running economically 4000 horse-power Climax boilers; preference given to one able and willing to take salary out of saving shown over present cost of operation; permanent position to right man; give age, education and experience. "New Jersey," Box 831, AMERICAN MACHINIST.

NEW YORK

Wanted—Mechanical draftsman familiar with mixing and kneading machinery for bread doughs, chemicals, paint, etc.; to a man thoroughly conversant with this line of machinery, we can offer a good position; state age, experience, if married or single, and salary expected. Address "Mixers," AM. MACH.

Superintendent with experience and good executive ability, capable of taking full charge of the manufacturing end of a modern plant employing 250 men in the manufacture of a line of A-1 machine tools; location, a pleasant town of 10,000 inhabitants, moderate rents, etc.; this is a good opportunity for the right man; state age, experience and salary expected, with references. Address "Manufacturer," AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—A general foreman, one who is experienced in all branches of engine work; applicant must be a hustler, thoroughly familiar with modern shop methods, able to handle men and show a clean record from past employers. Riverside Engine Company, Oil City, Pa.

WASHINGTON

Wanted—Superintendent for machine shop employing about sixty men; must have thorough knowledge of Pacific coast saw mill machinery; state references, age, experience and salary expected. Box 852, AMER. MACH.

FOREIGN

Superintendent wanted by large English telephone manufacturing company, for machine departments, consisting of presses, screw machines, drills, milling machines, etc.; must have had full experience on telephones, typewriters, clocks, or similar work requiring accurate methods for producing interchangeable parts, and complete knowledge of the design of press tools, jigs, and appliances for automatic screw machines; state age, experience, and salary. Box 853, AMER. MACH.

Wanted—A chief constructing engineer for high tension switches by a large German firm, manufacturing electrical supplies; engineers who have been engaged for a considerable time in managing construction work in this line and who speak and write the German language fluently, are requested to address applications, with a brief description of their previous experiences, statement of references, time when they will be able to enter upon their duties and expectations as to salary, to J. Z. 9861, care Rudolf Mosse, Annoncen-Expedition, Berlin S. W.

For Sale

For Sale—Foundry, wood and iron machine shop; all equipped. Box 74, Albion, N. Y.

Engine for Sale—One 25 horse-power Ball high-speed engine, fine condition, now in use. Call at 100 Hudson St., New York City.

For Sale—Patents No. 791,618, a variable speed device, and No. 852,057; a positive clutch. I. M. Foster, West Covington, Ky.

For Sale—Well equipped general machine shop in New Jersey; employing 15 to 20 hands; good reason for selling. P. O. Box 1216, New York City.

For Sale—Ten volume library, covering completely the work of the engineer and machinist; good as new; cost $50; will sell for $15. Address "T. M. T.," Box 425, Chicago.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address "L. N. O.," Box 425, Chicago, Ill.

For Sale—Two brand new Browne & Sharp automatic screw machines, one No. 0 and one No. 00, including all attachments for same. Rockford Automobile & Engine Co., Rockford, Ill.

Patent for sale; covers new method of adjustment for face and diameter of cutters and reamers; inserted blade; non-adjustable cutters made adjustable without materially changing construction or increasing cost. Box 850, AMERICAN MACHINIST.

Patent for sale; an inexpensive bevel and mitre gear cutting attachment for use with a shaper; will unquestionably do a class of work which has heretofore been possible only with very high priced special machines. Address W. W. Clippinger, 80 Atlas Bank Bldg., Cincinnati, Ohio.

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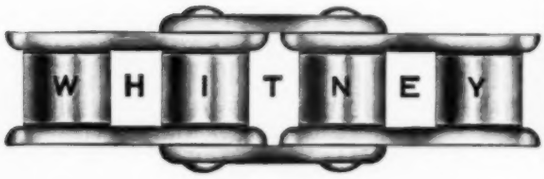

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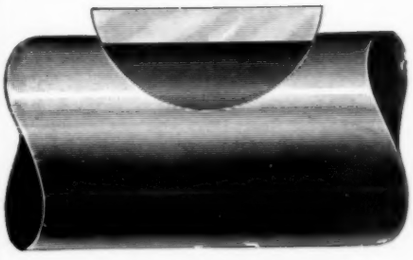

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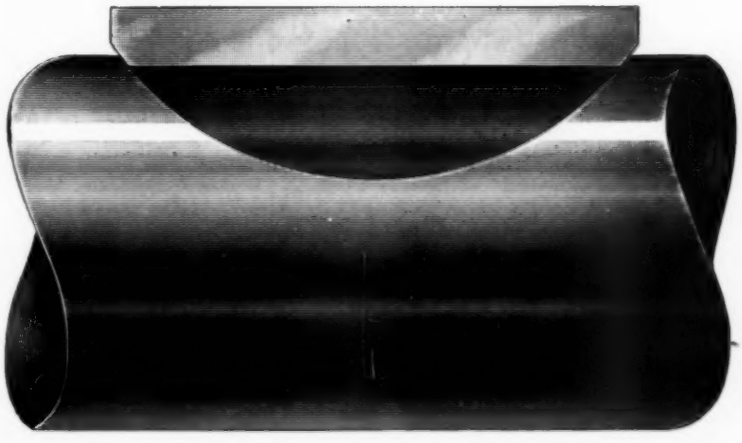


The Whitney Mfg. Co.,

Hartford, Conn., U. S. A.

Couplings, Shaft—*Continued.*
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Cranes
Brown Hoisting Mach. Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa.
Moore Co., Franklin, Winsted, Ct.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co. New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co, Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Armstrong Bros. Tool Co., Chicago, Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.

Cutting-off Machines—*Cont.*
Newton Mach. Tool Wks., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co., Cleveland, O.
Manville Bros. Co., Waterbury, Conn.

Dies, Sub-Press
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.

Drawing Materials
Alteneder & Son, Theo., Philadelphia, Pa.
Kolesch & Co., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler
American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.

Drilling Machines, Boiler—*Continued.*
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric
Chicago Pneumatic Tool Co., Chicago, Ill.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Ct.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.

Drilling Machines, Upright—*Continued.*
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.

Drills, Rail
Foote-Burt Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

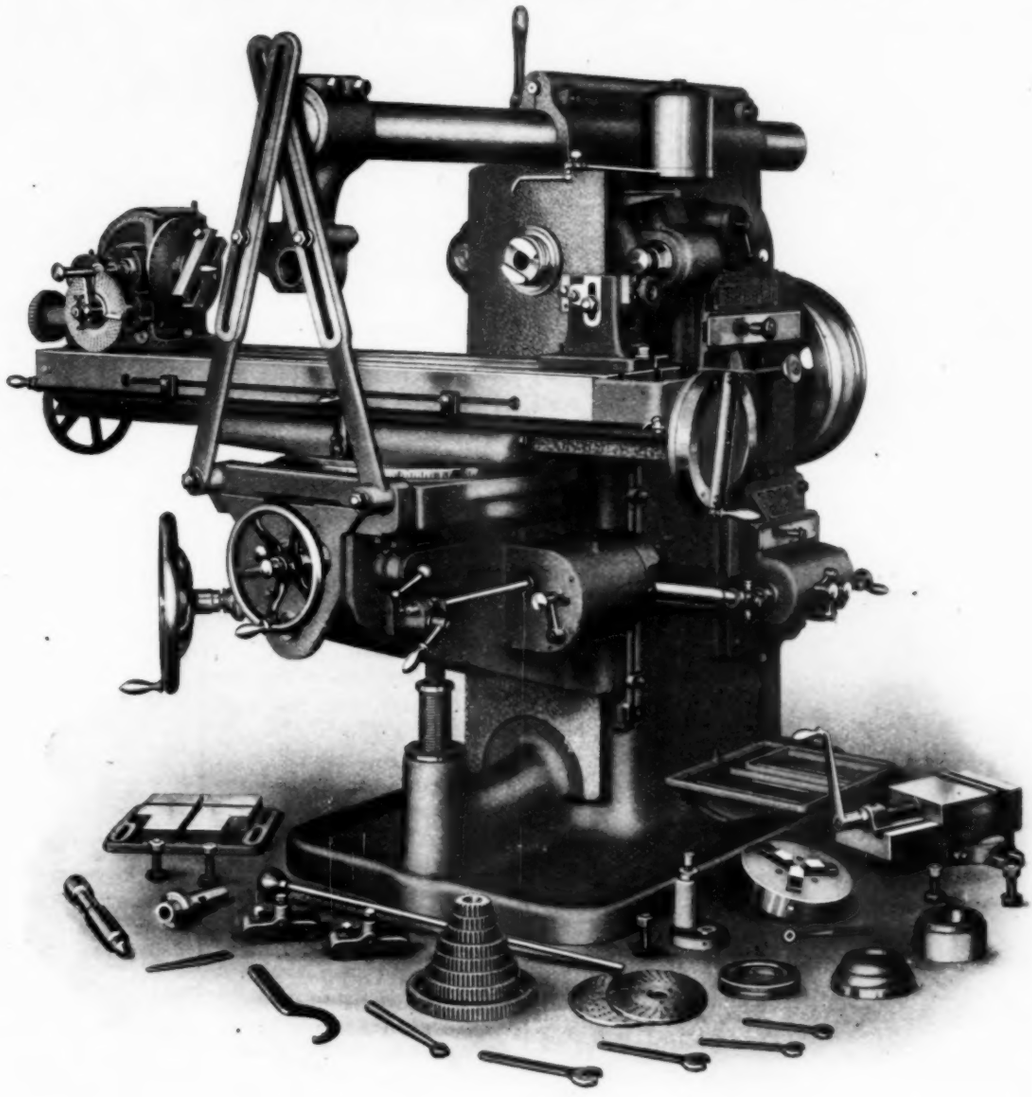
Drills, Rock
Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder
Graham Mfg. Co., Providence, R. I.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.



No. 4-A Heavy Universal Milling Machine.

CAPACITY. Longitudinal Feed, 35"; Transverse Feed, 12"; Vertical Feed, 20". Feeds, automatic.

A HEAVY AND RIGID MACHINE CAPABLE OF PRODUCING A LARGE AMOUNT OF WORK, MAINTAINING AT THE SAME TIME THE HIGHEST QUALITY OF ACCURACY IN THE FINISHED PRODUCT.

A Special Circular, describing the machine in detail, sent upon application.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Triumph Electric Co., Cincin., O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., Chicago, Ill.
Weston Elec. Instrument Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephen Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room

Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Engineers, Mechanical and Electrical

Crocker - Wheeler Co., Ampere, N. J.
Merritt, Jos., Hartford, Conn.
Seaver, John W., Cleveland, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.

Engines, Gas and Gasolene —*Continued.*

Grant Mfg. & Mach. Co., Bridgeport, Conn.
Struthers-Wells Co., Warren, Pa.

Engines, Motor

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.

Engines, Steam

American Blower Co., Detroit, Mich.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Eyelet Machinery

Manville Bros. Co., Waterbury, Conn.

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equipment & Eng. Co., Boston, Mass.

Fans, Electric

Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

American Blower Co., Detroit, Mich.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

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American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
Heller Bros. Co., Newark, N. J.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.
Simonds File Co., Fitchburg, Mass.

Filler, Iron

Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Filing Machines

Cochrane-Bly Co., Rochester, N. Y.
Henry & Wright Mfg. Co., Hartford, Conn.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Burke Machy. Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop

Bethlehem Steel Co., So. Bethlehem, Pa.
Billings & Spencer Co, Hartford, Conn.
Bullard Auto. Wrench Co., Providence, R. I.

Forgings, Drop—*Continued.*

Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Forgings, Hydraulic

Bethlehem Steel Co., So. Bethlehem, Pa.

Forgings, Steel

Bethlehem Steel Co., So. Bethlehem, Pa.
Cammel, Laird & Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Tindel-Morris Co., Eddystone, Pa.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Goldschmidt Thermit Co., New York.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co, Chicago, Ill.
Nash Company, Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Enameling

American Gas Furnace Co., New York.

Furnaces, Gas

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting

American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Oil

Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop

Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Ames & Co., B. C., Waltham, Mass.
Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam

Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.

Gear Cutting Machinery —*Continued.*

Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Machine Tool Wks., Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
Morse, Williams & Co., Phila., Pa.
Mutual Machine Co., Hartford, Conn.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waterbury Gear Co., Waterbury, Conn.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Horsburgh & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.

Gears, Rawhide

Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.